THE

Tea Research Institute

OF

Ceylon

BULLETIN No. 30

Annual Report for the Year 1948

Published by

THE TEA RESEARCH INSTITUTE OF CEYLON,

ST. COOMBS, TALAWAKELLE.

1949.

COMMONWEALTH MYCOLOGICAL INSTITUTE
16 FEB 1950

The Tea Research Institute of Ceylon

SCIENTIFIC STAFF

AT 1-1-1948

Director	...	Roland V. Norris, D.Sc. (Lond.), M.Sc. (Manc.), F.R.I.C.
Department of Plant Pathology.		
Pathologist and Deputy Director	...	C. H. Gadd, D.Sc. (Birm.)
Mycologist	...	D. R. Kemp, B.Sc. (Lond.)
Assistant Entomologist	...	G. D. Austin
Research Assistant	...	C. A. Loos
Assistants	...	D. J. W. Ranaweera
		W. T. Fonseka
		S. N. VanderWal
Department of Agricultural Chemistry.		
Agricultural Chemist	...	T. Eden, D.Sc. (Manc.), A.R.I.C.
Assistant	...	E. N. Perera
Field Assistants	...	M. Piyasena
		F. P. Jayawardana
Department of Biochemistry.		
Biochemist	...	J. Lamb, M.Sc. (Lond.), A.R.I.C., A.I.C.T.A.
Research Assistant	...	M. S. Ramaswamy, B.Sc. (Mysore), A.I.I.Sc.
Assistants	...	E. L. Keegel
		V. Mendis
		S. M. Gunaratnam
Department of Plant Physiology.		
Plant Physiologist	...	(Vacant)
Assistant	...	E. S. Rajiah
Field Assistant	...	F. H. Kehl
Small-Holdings Officers.		
		R. L. Illankoon
		F. D. Tillekeratne
		K. P. Abeyawickrema
Superintendent, St. Coombs Estate	...	F. C. Daniel

NOTE

The Laboratories of the Institute are situated at St. Coombs Estate, Talawakelle, and letters and enquiries should be addressed to the Director, Tea Research Institute of Ceylon, St. Coombs, Talawakelle. Telegraphic Address :—Research, Talawakelle, Telephone, Talawakelle 44 (Private Exchange). It is particularly requested that letters should not be addressed to officers by name.

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TWENTY-THIRD ANNUAL REPORT

OF THE

BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON

FOR 1948

Foundation.—The Tea Research Institute was established by Ordinance No. 12 of 1925, dated the 27th October, 1925. The constitution of the Board is laid down in the Ordinance; the personnel on the 1st day of January, 1948, was :—

Ex-Officio Members.

The Director of Agriculture (Mr. D. Rhind).

The Hon'ble the Financial Secretary (Represented by Mr. C. E. Jones, C.M.G., C.C.S., Secretary to the Treasury).

The Chairman of the Planters' Association of Ceylon (Mr. W. A. Paterson).

The Chairman of the Agency Section of the Planters' Association of Ceylon (Mr. D. F. Ewen).

Representatives of the Planters' Association of Ceylon.

Mr. R. C. Scott, C.B.E.

Mr. H. S. Hurst.

Mr. W. W. A. Phillips.

Representatives of the Agency Section of the Planters' Association of Ceylon.

Mr. J. C. Kelly.

Mr. W. H. Attfield.

Mr. F. A. Bond.

Representative of the Low-Country Products Association.

Mr. F. Amarasuriya.

Representative of the Small-Holders.

Mr. S. Vytilingam.

Chairman.—Mr. R. C. Scott, C.B.E.

Secretary.—Dr. Roland V. Norris, D.Sc., F.R.I.C.

Solicitors.—Messrs. Julius & Creasy.

Auditors.—Messrs. Ford, Rhodes, Thornton & Co.

Registered Office.—Office of the Planters' Association of Ceylon, "The Lawn," Colpetty, Colombo. (P. O. Box 855).

The following changes in the composition of the Board took place during the year :—

Mr. W. H. Gourlay succeeded Mr. D. F. Ewen as an *ex-officio* member on assuming the Chairmanship of the Agency Section of the Planters' Association of Ceylon on 19th January, 1948.

Mr. F. A. Bond, who returned from leave on 22nd December, 1947, relieved Mr. G. K. Newton, who had been acting for him since 10th April, 1947.

Mr. F. Amarasuriya, whose nomination as representative of the Low-Country Products Association expired on 16th November, 1947, was re-nominated to serve on the Board until such time as a fresh nomination was made.

Mr. G. R. Neale was appointed by the Agency Section of the Planters' Association of Ceylon to act for Mr. W. H. Attfield when the latter proceeded on short leave in May, 1948.

Mr. W. Neal de Alwis, J.P., U.M., was nominated by the Low-Country Products Association as their representative, *vice* Mr. F. Amarasuriya as from 20th May, 1948.

Mr. W. H. Attfield resumed his seat on the Board as a representative of the Agency Section of the Planters' Association of Ceylon on his return from leave on 5th August, 1948, and relieved Mr. G. R. Neale who was acting for him.

Mr. T. D. Perera, C.C.S., Acting Secretary to the Treasury, was nominated by the Hon'ble the Minister of Finance to act for Mr. C. E. Jones, C.M.G., C.C.S., when he proceeded on leave on 21st August, 1948.

Mr. H. S. Hurst was renominated by the Planters' Association of Ceylon to serve on the Board as one of their representatives as from 6th December, 1948.

Mr. R. S. V. Poulier, C.C.S., Acting Secretary to the Treasury, was nominated by the Hon'ble the Minister of Finance to serve on the Board during the absence from Ceylon of Mr. T. D. Perera, C.C.S.

COMMITTEES.

Finance Sub-Committee.—The Chairman, Tea Research Institute of Ceylon (Mr. R. C. Scott, C.B.E.); the Chairman, Planters' Association of Ceylon (Mr. W. A. Paterson); the Chairman, Agency Section of the Planters' Association of Ceylon (Mr. D. F. Ewen); Messrs. H. S. Hurst, W. H. Attfield, J. C. Kelly and the Director, Tea Research Institute of Ceylon (Dr. R. V. Norris).

Mr. W. H. Gourlay, on his appointment as Chairman of the Agency Section of the Planters' Association of Ceylon on 19th January, 1948, took the place of Mr. D. F. Ewen.

The Committee held two meetings during the year.

Estate and Experimental Sub-Committee.—The Director, Tea Research Institute of Ceylon (Chairman); the Chairman, Tea Research Institute of

Ceylon (Mr. R. C. Scott, C.B.E.); the Visiting Agent, St. Coombs Estate (Mr. A. H. Hall); the Superintendent, St. Coombs Estate (Mr. F. C. Daniel); Messrs. H. S. Hurst, P. B. Cruickshank, F. A. Bond, E. de la Mare, R. H. Horne, G. K. Newton, S. Bolster and Dr. T. Eden (Convener).

Mr. C. R. Lawton succeeded Mr. E. de la Mare on the latter's retirement from Ceylon.

The Committee held two meetings during the year.

Committee of Management, Junior Staff Medical Scheme.—The Chairman, Tea Research Institute of Ceylon (Mr. R. C. Scott, C.B.E.,); the Director, Tea Research Institute of Ceylon (Dr. Roland V. Norris) and Mr. G. D. Austin (representing the Junior Staff Association).

Trustees of the Junior Staff Provident Fund.—The Chairman, Tea Research Institute of Ceylon (Mr. R. C. Scott, C.B.E.); the Director, Tea Research Institute of Ceylon (Dr. Roland V. Norris); Mr. J. C. Kelly and Mr. E. N. Perera (representing the Junior Staff).

Visiting Agent.—Mr. A. H. Hall continued to act as Visiting Agent to St. Coombs during the course of the year and paid three visits of inspection to the estate. The thanks of the Board are due to him for his valuable services.

FINANCE.

The total receipts for the year amounted to Rs. 480,947 made up of Research Cess Rs. 415,593, Profit on St. Coombs Estate Rs. 54,494 and Interest and Miscellaneous Receipts Rs. 10,858. The receipts from the Research Cess were Rs. 13,470 above that for 1947 but the profit from St. Coombs Estate decreased by no less than Rs. 121,269. The receipts were thus Rs. 107,459 below that of 1947.

Total expenditure on Revenue Account amounted to Rs. 533,226 as against Rs. 434,305 in the previous year, the details being Research Revenue Expenditure Rs. 478,019, Interest on Government Loan Rs. 19,944 and Depreciation Rs. 35,263. Expenditure after allowing for depreciation therefore exceeded the Receipts in 1948 by Rs. 52,279, as against a surplus of Rs. 154,101 in 1947.

Capital expenditure (net) was incurred to the total amount of Rs. 250,538 in 1948 as against Rs. 117,621 in 1947, and comprised Rs. 195,917 on Assets and Rs. 54,621 in repayment of the Government Loan. Of the expenditure on assets, Rs. 163,392 was on account of new buildings.

Net liquid assets as at 31st December, 1948, after allowing for liabilities under the Furlough and Passages Reserve and Accrued Interest on the Government Loan, amounted to Rs. 328,257. The liability of Rs. 666,555 under the Depreciation Reserve was, therefore, covered to the extent of 49%. The amount outstanding against the Government Loan Account at the end of the year was Rs. 321,622.

ST. COOMBS ESTATE.

The year was a bad one for crop owing to very unfavourable weather conditions. Rainfall was very deficient and badly distributed in the first three months, and cold, wet and sunless weather in July again restricted crop. The final yield was therefore only 207,644 pounds (713 pounds per acre), as against 262,132 pounds in 1947. The average yield for the Dimbula District was 624 pounds per acre.

Blister Blight was more in evidence than in 1947 when a light monsoon with frequent sunny intervals checked the disease.

With the exception of 6,452 pounds used for local consumption, the crop was sold on the open market and realised a net price of 165.71 cents per pound. Cost of production was 135.75 cents, or 33.10 cents higher than in 1947. The above figure included 43.54 cents per pound on account of Dearness allowance.

In the above circumstances, the profit on St. Coombs was reduced to Rs. 54,494 (Rs. 187 per acre) as against Rs. 175,763 (Rs. 604 per acre) in the previous year.

PUBLICATIONS.

Owing to shortage of staff and pressure of other work, the publication of the *Tea Quarterly* was suspended during the year. Subscriptions, which amounted to Rs. 3,808-89, were carried forward to 1949.

The Institute's publications are sent free of charge to Proprietors, Directors, Superintendents and Assistant Superintendents of all Ceylon Tea Estates of over 10 acres in extent, and to London and Colombo Agency Firms dealing with tea if they register their names with the Director.

Other persons can obtain the publications on payment of annual subscription of Rs. 15 if resident in Ceylon or India, and £1.5.0 if resident elsewhere. Single numbers of the *Tea Quarterly* or Bulletins can be obtained at Rs. 2-50, or 4 shillings per copy.

There was a large demand for back numbers during the year, and while many parts of the *Tea Quarterly* and some of the Bulletins are now out of print, the following are still available :—

Tea Quarterly.—Vol. 2, pt. 4.
Vol. 3, pts. 1 and 2.
Vol. 5, pts. 2, 3 and 4.
Vol. 7, pts. 2 and 3.
Vol. 10, pt. 1.
Vol. 12, pts. 1, 2, 3 and 4.
Vol. 13, pts. 1, 2, 3 and 4.
Vol. 14, pts. 1, 2, 3 and 4.
Vol. 15, pts. 1 and 2. (Complete volume).
Vol. 16, pts. 1 and 2. (do do)
Vol. 17, pt. 1. (do do)
Vol. 18, pts. 1, 3 and 4.
Vol. 19, pt. 2.

Bulletins.—Nos. 1, 4, 7, 8, 9, 11, 14, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28 and 29.

ACKNOWLEDGMENTS.

As usual close co-operation has been maintained with the Ceylon Association in London, the Planters' Association of Ceylon, and other bodies concerned with the Tea industry and the grateful thanks of the Board are due to all of them for their continued interest and assistance in the working of the Institute.

Thanks are also due to the Planters' Association for having placed at our disposal the use of their rooms for meetings of the Finance Sub-Committee and the Board.

The Audited Statement of Accounts and the Balance Sheet for 1948 are attached, together with the report on St. Coombs Estate and those of the Director and the Scientific Staff dealing with the research activities of the Institute.

ROLAND V. NORRIS,
Secretary.

THE TEA RESEARCH INSTITUTE OF CEYLON

BALANCE SHEET AS AT 31st DECEMBER, 1948

1947 Rs.	LIABILITIES	Rs. Cts.	Rs. Cts.
	CREDITORS :—		
5,174	Accrued Interest on Loan	4,422·30	
41,328	Sundry Creditors—Estate	53,019·14	
17,757	Sundry Creditors—Research	21,795·71	
45	Subscriptions for Publications received in advance.	3,808·89	
—	Contribution for Cart Road received in advance	301·00	83,347·04
	FURLOUGH PASSAGES PROVISION :—		
	At 31st December, 1947	19,109·76	
	Additions during 1948	20,882·00	
		39,991·76	
19,109	*Less* : Payments in 1948	19,128·57	20,863·19
	DEPRECIATION PROVISION :—		
	At 31st December 1947	631,422·01	
	Added at 31st December 1948	35,263·28	
		666,685·29	
631,422	*Less* : Items scrapped in 1948	130·88	666,554·41
c/o 714,835		Carried over Rs.	770,764·64

1947 Rs.	ASSETS	Rs. Cts.	Rs. Cts.
	DEBTORS :—		
	Principal Collector of Customs November and December cess	65,229·52	
	Medical Fund	2·50	
	Fertiliser Control Bureau	1,420·84	
	Subscription Received from Mrs. Hewavitarne	17·50	
35,114	Recovered from Imperial Chemical Industries against Sodium Sulphide	271·19	66,941·55
	DEBTORS—RESEARCH :—		
	Ceylon Association in London £. 113·18·11 at Exch : 1/6	1,519·27	
	Loans to Research Staff	11,245·63	
	Deposit	175·00	
	Accrued interest on fixed deposits and investments	1,672·01	
		14,611·91	
22,795	ESTATE Debtors and Deferred Charges	8,477·82	23,089·73
	STOCKS IN HAND :—		
	Stocks on Estate	25,894·83	
99,210	Tea 24,270 lbs. at Prices Since Realised	42,494·00	68,388·83
c/o 157,119		Carried over Rs.	158,420·11

THE TEA RESEARCH INSTITUTE OF CEYLON

BALANCE SHEET AS AT 31st DECEMBER, 1948—(*contd.*)

1947 Rs.	LIABILITIES	Rs. Cts.	Rs. Cts.	1947 Rs.	ASSETS	Rs. Cts.	Rs. Cts.
B/f 714,835	Brought forward		770,764·64	B/f 157,119	Brought forward		158,420·11
	NOTE :—				INVESTMENTS (AT COST)		
	Loan from Ceylon Government	321,621·55			Rs. 20,000/- 3¼% Ceylon Government National Loan 1956	20,000·00	
	Revenue from Cess on Estates and other sources applied to Capital Expenditure	1,795,627·60			Rs. 30,000/- 3½% Ceylon Government Loan 1957/62	29,512·50	
	General Funds Spent on Capital Expenditure	338,297·48			Rs. 15,000/- 3% Ceylon Government Defence Bonds 1952	15,000·00	
	Value of Fixed Assets, at Cost, at 31st December, 1948	2,455,546·63			Rs. 20,000/- 3% Ceylon Government Defence Bonds 1949	20,000·00	
					£. 6,750/- 2½% National War Bonds 1952/54	90,000·00	
					£. 2,300/- 3½% War Loan	32,434·76	
				336,875	£.2,063·18·1 4% Funding Loan 1960/90	29,928·06	236,875·32
					(Approximate market value Rs. 241,662/59)		
					CASH :—		
					On Current Account with National Bank	18,398·78	
					Petty Cash	2,056·25	
					Fixed Deposits	12,121·95	
					Estate– National Bank, Colombo Rs. 3,976·60		
				185,361	Estate—in Hand ,, 618·15	4,594·75	37,171·73
					FUNDS OVERSPENT :—		
					To 31st December 1947	35,480·24	
					Capital Expenditure 1948	195,916·86	
					Government of Ceylon Loan Repayment	54,621·12	
				35,480	Add Deficit on Revenue Account	52,279·26	338,297·48
Rs. 714,835			Rs. 770,764·64	Rs. 714,835			Rs. 770,764·64

We have examined the above balance sheet with the books of the Tea Research Institute of Ceylon and St. Coombs Estate and have obtained all the information and explanations we have required. The allocations of capital expenditure and of research revenue expenditure as made by the director have been accepted by us. In our opinion, the foregoing balance sheet is properly drawn up so as to exhibit a true and correct view of the financial affairs of the Institute as at 31st December 1948, according to the best of our information and the explanations given to us and as shown by the books.

Colombo, 7th May, 1949.

(Sgd.) FORD, RHODES, THORNTON & CO.,
Chartered Accountants.

THE TEA RESEARCH INSTITUTE OF CEYLON

ESTATE WORKING ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1948

1947 Rs.	EXPENDITURE	Rs. Cts.	Rs. Cts.	1947 Rs.	INCOME		Rs. Cts.	Rs. Cts.
	To ESTATE EXPENDITURE—REVENUE :—				By TEA SALES :—			
68,301	General Charges	80,988·46			Colombo	201,192 lbs.	339,174·22	
50,324	Upkeep	49,373·72			Local	653 ,,	859·49	
19,720	Cultivation	20,085·80			Broken Mixed	4,422 ,,	1,768·80	
57,936	Harvesting	62,698·95			Bio Dept.	152 ,,	251·28	
72,904	Manufacture	68,740·18	281,887·11		Gratis	1,225 ,,	—	
				450,790		207,644 lbs.		342,053·79
7,177	,, Colombo Brokerage and Handling Charges		5,403·62					
—	,, Motor Road Roller Account		268·58	1,335	,, Motor Road Roller Account			—
175·763	,, Balance Carried Down		54,494·48					
Rs. 452,125			Rs. 342,053·79	Rs. 452,125				Rs. 342,053·79

REVENUE ACCOUNT AS AT 31st DECEMBER, 1948

1947 Rs.		Rs. Cts.	Rs. Cts.	1947 Rs.		Rs. Cts.
	To ADMINISTRATION OF THE BOARD :—			175,763	By Balance from Estate Working Account	54,494·48
240	Planters' Association of Ceylon	240·00		120	,, Rent of Caddy	—
3,121	Travelling of the Board	3,215·05		402,130	,, Tea Cess	415,593·69
9·660	Clerical Staff	12,245·00		161	,, Miscellaneous Receipts	7·69
1,022	Telephone Operators	1,488·00		—	,, Gain on Realisation of Investments	2,061·50
1,246	Office Peon	1,060·08		—	,, Guest House Receipts	416·75
739	Postages	598·37		10,232	,, Interest on Investments and Deposits	8,372·49
2,016	Stationery	1,990·63		—	,, Balance being excess of Expenditure over Income for 1948	52,279·26
367	Advertising	—				
458	Telegrams, Trunk Calls	523·46				
58	Printing	303·05				
53	Legal Expenses	—				
1,301	Auditors Fees	1,797·41				
164	Contingencies	208·84				
5,226	Dearness Allowance	6,363·00	30,032·89			
c/o 25,671			Carried over Rs. 30,032·89	c/o 588,406		Carried over Rs. 533,225·86

REVENUE ACCOUNT AS AT 31st DECEMBER, 1948—*(contd.)*

1947 Rs.		Rs. Cts.	Rs. Cts.	1947 Rs.		Rs. Cts.
B/f 25,671	Brought forward		30,032·89	B/f 588,406	Brought forward	533,225·86
	To PERSONAL EMOLUMENTS OF SCIENTIFIC STAFF :—					
24,979	Director	28,500·00				
21,416	Pathologist	25,950·00				
20,250	Agricultural Chemist	25,324·23				
18,000	Plant Physiologist	12,347·06				
16,764	Bio-Chemist	20,330·35				
3,120	Mycologist	9,317·83				
	Leave Pay & Allowances of Retiring Officers	18,141·93				
21,000	Dearness Allowance	20,844,19				
3,975	Proportion 30% Superintendent's Pay	4,157·00	164,912·59			
	,, EMOLUMENTS—JUNIOR AND SUB-SCIENTIFIC STAFF :-					
47,673	Junior Scientific Staff	60,837·44				
5,328	Laboratory Attendants and Fieldman	8,779·56				
19,812	Dearness Allowance	23,510·32	93,127·32			
	,, LABORATORY :—					
6,845	Equipment and General Working Expenses	6,962·41				
9,953	Special Provision for Joint Research on Tea	4,500·00				
2,142	Furniture & Office Equipment	260·65	11,723·06			
	,, LIBRARY AND PUBLICATIONS :—					
2,348	Library	3,161·83				
Credit 1,405	Publications	773,42	3,935·25			
c/o 245,871		Carried over Rs.	303,731·11	c/o 588,406		Carried over Rs. 533,225·86

REVENUE ACCOUNT AS AT 31st DECEMBER, 1948—(*contd.*)

1947 Rs.		Rs. Cts.	Rs. Cts.	1947 Rs.		Rs. Cts.
B/f 245,871	Brought forward		303,731·11	B/f 588,406	Brought forward	533,225·86
	To SMALL HOLDINGS :—					
12,377	Salaries and House Allowances	21,132·21				
5,346	Travelling and General Expend.	11,186·45				
43	Working Expenses	546·89				
2,127	Dearness Allowance	2,925·60	35,791·15			
	,, FIELD AND FACTORY EXPERIMENTS :—					
6,652	Agricultural Chemist	7,506·22				
4,447	Plant Physiologist	3,359·13				
1,934	Miscellaneous Field Experiments	322·54				
6,748	Factory Experiments	5,553·18	16,741·07			
	,, TRAVELLING OF STAFF					
4,325	Officers Expenses	5,735·12				
174	Insurance of Car and Licence	173·56				
864	Drivers Wages	1,032·00				
389	Drivers Batta	511·85				
4,068	Running Expenses & Repairs	4,942·06				
758	Dearness Allowance	892·50	13,287·09			
	,, MAINTENANCE OF BUILDINGS :—					
595	Laboratory	451·03				
3,725	Six Senior Staff Bungalows	2,216·71				
1,487	Junior Staff Bungalows	2,185·57				
404	Clerks Bungalows	465·70				
2,576	Miscellaneous Lines and Buildings	1,570·53				
48	Passara Buildings	235·00				
	Replacements and Renewals					
949	Junior Staff Bungalows	2,471·47				
242	Replacements Senior Staff Bungalows	959·46				
15	Guest House	17·55	10,573·02			
c/o 306,164	Carried over	Rs.	380,123·44	c/o 588,406	Carried over	Rs. 533,225·86

REVENUE ACCOUNT AS AT 31st DECEMBER, 1948—(*contd.*)

1947 Rs.		Rs. Cts.	Rs. Cts.	1947 Rs.		Rs. Cts.
B/f 306,164	Brought forward		380,123·44	B/f 588,406	Brought forward	533,225·86
	To General Services :—					
9,213	,, Electric Power	11,304·50				
980	Mechanic	1,500·00				
728	Telephone Rent and Maintenance of Lines	678·50				
600	Roads	750·00				
1,026	Sanitation	1,103·48				
4,266	Water Supply	2,908·08				
414	Tappal Lorry Fees	294·00				
28	Nettikans and Drains	60·14				
1,212	Upkeep of Grounds	1,877·89				
632	Guest House	673·85				
4,912	Dearness Allowance	7,296·21				
—	33 1/3rd% Storeman's Salary	602·46	29,049·11			
	Miscellaneous :—					
257	Incidentals	302·89				
10,628	Ceylon Planters' Prov. Society	25,532·98				
5,630	Provdt. Fund Junior Scientific Staff	11,304·61				
1,930	— do — Sub-Staff	3,833·68				
15,000	Passages	13,000·00				
200	Ceylon Nursing Assn. and Fraser Nursing Home	215·00				
441	Medical Fees—Sub-Staff	608·12				
1,161	Medical Scheme—Junior Staff	1,338·00				
4,653	Insurances	6,282·01				
1,556	Watchmen and Caretakers	1,152·56				
240	Observatory Allowance	600·00				
1,733	Proportion Supdt's Furlough and Passage	1,820·00				
579	Dearness Allowance	357·08				
—	Provdt. Fund—Retiring Staff	2,299·60				
c/o 374,183	Carried over	Rs. 68,646·53	409,172·55	c/o 588,406	Carried over	Rs. 533,225·86

THE TEA RESEARCH INSTITUTE OF CEYLON

Dr. **REVENUE ACCOUNT AS AT 31st DECEMBER, 1948**—(*contd.*) **Cr.**

1947		Rs. Cts.	Rs. Cts.	1947		Rs. Cts.
Rs.				Rs.		
B/f 374,183	Brought forward		409,172·55	B/f 588,406	Brought forward	533,225·86
	To MISCELLANEOUS (Continued)					
	Brought forward	68,646·53				
586	Conference Expenses	—				
—	Junior Staff Association	200·00	68,846·53			
22,829	,, GOVERNMENT OF CEYLON LOAN INTEREST		19,943·50			
33,708	,, DEPRECIATION		35,263·28			
3,000	,, RETIRING GRATUITY		—			
154,100	,, BALANCE		—			
Rs. 588,406			Rs. 533,225·86	Rs. 588,406		Rs. 533,225·86

(Sgd.) ROLAND V. NORRIS,
Director.

THE TEA RESEARCH INSTITUTE OF CEYLON

Dr. **CAPITAL ACCOUNT AS AT 31st DECEMBER, 1948** **Cr.**

EXPENDITURE	To 31-12-47	Additions in 1948	Scrapped in 1948	Total	RECEIPTS		
	Rs. Cts.	Rs. Cts.	Rs. Cts.	Rs. Cts.		Rs. Cts.	Rs. Cts.
To Land—Including Development	923,717·90	7,701·93	—	931,419·83	By Government of Ceylon :— Loan on Mortgage at 5½% per annum	1,000,000·00	
,, Buildings & Lines	1,000,590·67	163,391·79	—	1,163,982·46	*Less :* Repayments to 1948	678,378·45	321,621·55
,, Furniture and Equipment	83,590·74	10,087·94	—	93,678·68	,, Revenue Applied to Capital Purposes to 31-12-47	1,847,906·86	
,, Laboratory Equipment	45,581·27	44·33	130·88	45,494·72	*Less :* 1948 Overspent	52,279·26	1,795,627·60
,, Experimental Machinery	30,657·19	2,636·82	—	33,294·01	,, Funds Overspent to 31-12-47	35,480·24	
,, Motor Road Roller	7,386·03	—	—	7,386·03	*Add :* 1948 Overspent	302,817·24	338,297·48
,, Motor Car	8,525·00	—	—	8,525·00			
,, Motor Lorry	7,860·00	—	—	7,860·00			
,, Machinery Estate	151,720·97	12,184·93	—	163,905·90			
	Rs. 2,259,629·77	196,047·74	130·88	2,455,546·63			Rs. 2,455,546·63

(Sgd.) ROLAND V. NORRIS,
Director.

THE TEA RESEARCH INSTITUTE OF CEYLON

LOAN ACCOUNT

	Rs. Cts.			Rs. Cts.
To Government of Ceylon	Rs. 1,000,000·00	By Repayment to		
		31-12-48 (Principal)	...	678,378·45
		,, Balance	...	321,621·55
	Rs. 1,000,000·00			Rs. 1,000,000·00

(Sgd.) ROLAND V. NORRIS,
Director.

REPORT

ON

ST. COOMBS ESTATE

FOR 1948

Superintendent.—Mr. F. C. Daniel since 1946.

Acreage :—

	A.	R.	P.
Tea in bearing	291	0	28
Land available for cultivation ...	20	0	00
Buildings and gardens	43	3	11
Waste land and ravines	32	0	24
Fuel Clearings	36	3	14
Total ...	423	3	37

Weather :—(Estate Gauge).

	Rainfall Inches.	Wet Days.	Sunshine Hours.
Registered in 1948 ...	89.02	246	1944.62
„ „ 1947 ...	90.59	219	1988.75

Crop :—

	1948	1947
Estimate ...	250,000 lbs.	250,000 lbs.
Total Crop (including B. M.)	207,644 „	262,132 „
Yield per acre on 291 acres ...	713 „	900 „

Yield per acre.—As all previous records show, when the heavy cropping months in the first half of the year have been poor, the final yield has been low. In 1947 this trend was accentuated by the lowest yield for any month during the last 14 years in July which yielded 21 lbs. per acre only. Favourable climatic conditions later lead to only a moderate response after such a set-back. The average yield per acre for the estate for the last 10 years was 725 lbs.

Prices and Total Crop sold :—

Year	Total Crop sold	Gross Price per lb.	Net price per lb.
1948 ...	206,419 lbs.	165.71 cts.	163.09 cts.
1947 ...	260.565 „	173.61 „	170,86 „

Cost of Production :—

	1948	1947
Estimate ...	116.15 cts.	107.06 cts.
Actual ...	135.75 „	102.69 „

Dearness allowance included in the above was :—

	1948 per lb.	1947 per lb.
Senior and subordinate staff ...	5.37 cts.	3.58 cts.
Factory Staff	1.78 „	1.39 „
Factory labour	2.83 „	2.24 „
Other labour	33.56 „	23.55 „
Total ...	43.54 „	30.76 „

Profit on Estate Working :—

1948	...	Rs. 54,494.00
1947	...	„ 175,763.00

Capital Expenditure :—

1948	...	Rs. 89,206	42.96 cts. per lb.
1947	...	„ 41,949	16.00 „ „

The expenditure was mainly incurred on twelve cottage type line rooms, one Subordinate Staff Bungalow, a Direct Fired Heater Furnace to the E. C. P. Drier, an Air Blower, A Dispensary, renewal of roofing to lines, extensions to subordinate staff quarters, 2 creche sheds, 1 weighing shed, alterations to estate office, and converting old office into a Schoolmaster's quarters.

Manuring.—The policy of applying manure at 6, 16, and 26 months after pruning at the rate of 35, 45 and 55 lbs. nitrogen per acre was continued but, owing to delayed deliveries, a small acreage did not receive the application at 26 months.

Green Manures.—The bush manure used was chiefly *Tephrosia vögelii*, but a further acreage was planted up with *Gliricidia sepium*, and some *Albizzia sumatrana* plants were put out. It is encouraging to see the previously supplied *Gliricidia sepium* showing definite signs of becoming established in the older tea fields. Good crops of *Tephrosia vogelii* were forked in.

Pruning.—The programme drawn up in consideration of Blister Blight attack for dry weather recovery was adhered to. A considerably lighter type of pruning was done where possible, and throughout all side branches below the pruning level were left untouched.

Weeding.—The whole estate was weeded on Estate Account, as it was found impracticable to give the work out on family contracts. A very heavy growth of *Polygonum nepalense* showed up in the S. W. monsoon months. Extra expenditure was incurred in the removal of fern and bamboo grass, while regular rounds were continued removing Illuk and Cootch grass.

Pests and Diseases.—Two fields, Nos. 5 and 8, which suffered very badly from Blister Blight attacks in 1947 were rested during January and February 1948 for some weeks, and then cut across; they greatly benefit by this procedure. Attacks of Blister Blight during the year were moderately

heavy, as was the case with other estates in the district, but owing to the new pruning programme no fields suffered to the extent of the two mentioned. The wood growth in No. 10 field was found to be very disappointing when pruned at the end of the year, the field having been rested for five months before pruning; this is attributed to Canker inherent in these bushes.

Labour.—This was sufficient and showed some improvement.

Lines.—Congestion is being further relieved by the construction of new cottage type lines.

Factory and Machinery.—The factory building is in good order, and new hessian was put in to replace very badly worn tats in a portion of the lofts. The new Direct Fired Furnace worked with good results and gave no mechanical trouble from its inception.

F. C. DANIEL,

Superintendent.

METEOROLOGICAL OBSERVATIONS, 1948.

ST. COOMBS.

(Laboratory Gauge)

MONTH	TEMPERATURES							RAINFALL		DAYS		SUNSHINE	
	Mean Maximum	Difference from average (15 years)	Mean Minimum	Difference from average (15 years)	Adopted Mean	Mean on grass	Mean Relative Humidity	Inches	Difference from average (15 years)	Days	Difference from average (15 years)	Hours	Difference from average (15 years)
January	74·7	+ 0·5	56·8	+ 1·5	65·8	50·5	74	4·06	+ 0·79	9	- 1	175·05	- 32·54
February	78·2	+ 1·7	53·2	- 1·5	65·7	46·3	64	0	- 2·54	0	- 8	229·00	+ 8·66
March	79·6	+ 2·1	55·3	0	67·4	51·5	63	4·58	+ 0·07	13	+ 1	246·98	+ 12·04
April	78·0	+ 0·4	56·8	- 1·1	67·4	55·6	78	8·98	+ 2·61	17	+ 1	217·90	+ 12·52
May	75·8	+ 5·7	60·6	+ 0·7	68·2	61·6	84	9·84	- 3·38	23	+ 4	155·17	- 2·97
June	71·5	+ 0·7	60·6	+ 0·2	66·0	61·5	88	17·20	+ 4·77	23	- 3	108·83	+ 9·36
July	69·4	- 0·4	60·2	+ 0·7	64·8	60·9	94	14·99	+ 2·35	30	+ 4	91·92	- 16·00
August	70·3	- 0·7	60·1	+ 1·0	65·2	60·8	86	5·13	- 4·18	28	+ 3	118·37	+ 0·92
September	73·4	+ 1·2	57·1	- 1·2	65·2	55·8	82	2·61	- 4·52	14	- 7	187·05	+ 47·14
October	75·2	+ 1·9	56·7	- 1·2	66·0	55·8	81	6·97	- 2·83	19	- 3	137·33	- 16·30
November	74·5	+ 1·2	57·1	- 0·5	65·8	54·3	79	6·38	- 1·84	18	- 3	165·92	+ 8·83
December	73·4	- 0·4	57·7	+ 1·7	65·6	54·6	77	6·92	+ 1·76	19	+ 4	111·10	- 68·97
Annual	74·5	+ 1·2	57·7	0	66·1	55·8	79	87·66	- 6·94	213	- 8	1944·62	- 37·31
	Means							Totals					

REPORT

OF

THE DIRECTOR,

TEA RESEARCH INSTITUTE OF CEYLON

FOR 1948

Finance.—The total receipts for the year were markedly below those for 1947, this being due to the reduced profit on St. Coombs Estate which amounted to Rs. 54,494 as against Rs. 175,764.

Expenditure on Revenue Account was Rs. 533,226, this being made up of Rs. 478,019 on Research Revenue Account, Rs. 19,944 Interest Charges on the Government Loan and Rs. 35,263 against Depreciation.

After allowing for depreciation, there was, therefore, a deficit on Revenue Account of Rs. 52,279. With Capital Expenditure amounting to Rs. 250,538 the total deficit for the year was Rs. 302,817 and this had to be met from reserves.

The Capital expenditure included Rs. 163,392 on additional buildings and Rs. 54,622 in repayment of the Government Loan.

After allowing for liability under the Furlough and Passage Reserve and Accrued Interest on the Government Loan, the Depreciation Reserve was covered by cash and liquid assets to the extent of 49 per cent.

The above figures are a sufficient indication that a cess of 14 cents per 100 pounds of tea exported is quite inadequate to maintain the Institute under existing conditions.

A Sub-Committee was, therefore, appointed to examine the future position. After a very detailed examination the Board were forced to the conclusion that the cess should be increased to twenty-five cents and an application was duly made to the Government for an amendment to the Ordinance to this effect. This proposal was duly approved by Parliament in December 1948; at the same time the representation of the Low Country Products Association on the Board was increased from one to three members.

St. Coombs Estate.—Conditions were unfavourable to crop which was reduced to 207,644 pounds or 713 pounds per acre. This figure, however, compared favourably with the average for the Dimbula District which was 624 pounds. Rainfall was markedly deficient in the first months of the year and experience has shewn that in such a case it is seldom in Dimbula that the early loss of crop is made good. The South West monsoon was

heavier than in 1947, and with continuously wet, cold and sunless weather in July the crop for that month amounted to only 21 pounds per acre. Under such conditions Blister Blight was naturally more in evidence.

The crop was sold at a nett price of 165.71 cents per pound, a figure 5.15 cents below that for the previous year.

Staff.—The Pathologist returned from leave at the end of January but the staff was further depleted by the resignation of Dr. Tubbs in the middle of the year following which Dr. Eden took over the Physiological Department in addition to his own duties. The loss of Dr. Tubbs's services to the Institute was a severe one. In addition to the work in his own Division on pruning, tea selection and vegetative propagation, during the absence of Dr. Gadd he had the problem of Blister Blight to face and did notable service to the Industry by his work in this connection.

The Institute was fortunate in securing without undue delay a successor to Dr. Tubbs though the officer selected did not arrive in Ceylon until the beginning of January 1949.

It had been hoped to appoint during the year an officer to organise the proposed Sub-Station in the Low-country and a very suitably qualified officer was in fact selected. Subsequently, however, owing to unavoidable circumstances the officer in question found it necessary to withdraw his name and the post still remains unfilled. As Doctors Gadd's and Eden's services will also be lost to the Institute early in 1949 the position in regard to staff is a serious one as the supply of research officers with the type of experience desired by the Institute is far less than the present demand.

This is the more unfortunate as, following on the arrival of Blister Blight in Ceylon and as the result of anxiety in regard to the conditions of some tea areas, particularly up-country, the advisory work of the Institute has increased very materially and the demand for visits to estates and for addresses to District Planters' Associations is now very heavy indeed.

Fertilisers.—The fertiliser position shewed little improvement; in fact so far as potash was concerned supplies were even more restricted owing to shipping difficulties arising from the disturbed conditions in Palestine. In consequence, Fertiliser Rationing had to continue. There were indications, however, that the rubber industry is likely to require smaller quantities of fertilisers in the near future in which case tea will be the gainer.

In the report for 1947 reference was made to the deterioration in certain areas of tea up-country, the bushes in such cases carrying less foliage and shewing a general lack of vigour and cropping capacity. In the present circumstances it was perhaps not unnatural that Blister Blight came to be regarded as the primary cause of this condition.

This disease has undoubtedly aggravated the position but there is every reason to think that such deterioration has been going on for some considerable period and that we are now seeing the cumulative effect of a number of factors, such as reduced manuring and cultivation coupled with harder and harder pruning and harder and harder plucking.

Blister Blight.—Conditions were generally more favourable to the disease in the wet zone than in 1947, and this was particularly so on estates in misty areas. The soundness of the Institute's suggestion in regard

to pruning times and methods was again demonstrated but the difficulty of how best to protect tea in plucking still remains. Spraying seems the only radical solution but to what extent this will become an economic proposition is a matter for further investigation. The nature of the terrain, climatic conditions and similar factors make spraying a peculiarly difficult and costly problem in Ceylon which is unlikely to be solved without modification and improvement in the spraying equipment at present available. This is naturally a matter which is receiving the attention of the Institute as is also the cognate problem of finding more efficient and suitable fungicides.

As a background to such field measures fundamental work has been carried out in the Pathology Division on the causative fungus itself, its life history and method of attack. This is now more or less complete and forms a necessary and satisfactory background for a study of protective measures in the field.

In this connection attention is called to that part of the Pathologist's report dealing with the effect on Blister Blight of Brown Blight, caused by *Colletotrichum camelliae*. Some misunderstanding seems to have arisen on this subject and the impression gained that Brown Blight is a parasite of *Exobasidium*. It will be seen that this is not the case. To a certain extent, however, a secondary invasion by *Colletotrichum* may be regarded as beneficial since it leads indirectly to an earlier death of the invading Blister Blight fungus and spore formation by the latter is thereby reduced. It is, however, unlikely to reduce Blister Blight to the status of an unimportant pest.

On the assumption, for which there appears to be every justification, that Blister Blight, whatever paliative measures be adopted, is unlikely to be eradicated, the importance of discovering more resistant varieties of tea is obviously of major interest. That such material exists there now seems to be little doubt and as the methods of multiplication by vegetative propagation become more familiar and more widely practised, there should gradually come into being an increasing supply of improved planting material which may assist to an important degree as a long term measure in the fight against Blister Blight.

In carrying out such selection work, however, it is necessary to stress that the basis of selection should not be restricted merely to resistance to Blister Blight. General vigour, cropping capacity and the ability to produce good quality tea are factors of equal importance.

The Agricultural Chemist's attention was chiefly focussed on the response given by tea to applications of phosphoric acid and potash, a problem which in the past has given somewhat confusing results. The conclusions now reached are summarised in Dr. Eden's report and described in more detail in the Special Monograph (No. 1) issued by the Institute, dealing with the work of this Department during the past twenty years.

In the Biochemical Division the amount of advisory work continues to increase and this has been particularly the case in regard to rolling methods. It is satisfactory to note that more attention is now being given to tea manufacture and with plucking standards rising there should soon be evident a further improvement in the general standard of Ceylon teas which naturally suffered during the war years.

Apart from the more purely biochemical work of the section, interest has been concentrated to a considerable extent on a comparison of the results to be obtained from epicyclic and batten and pressure cap rolling.

This is described in some detail in Mr. Lamb's Report. Epicyclic rolling can give perfectly good results provided the leaf is of good standard. Otherwise, brownish fibrous teas may be obtained inferior to those resulting from batten/pressure cap rolling.

During the year Mr. Lamb was able to visit the Tocklai Experimental Station and the North East India tea areas.

General.—As has already been indicated the advisory work of the Institute is becoming heavier and heavier while, temporarily, staff has been reduced owing to the difficulty in filling vacancies. The number of visitors to the Institute is increasing rapidly while the Scientific Staff on their part have to spend much more time than formerly on visits to estates and lectures and talks at Planters' Association Meetings.

This naturally raises difficulties in regard to the laboratory aspect of the Institute's work and the strain on the staff has been considerable. The extent to which the tea industry as a whole now makes use of the Institute is, however, a pleasing indication of the confidence now shewn in its work.

We have again to acknowledge the support extended to us by the Associations concerned with the Industry and to express our thanks to Agents and Superintendents who have assisted us in our work and extended such generous hospitality. Especially we would thank Mr. R. H. Horne and the numerous other Tasters in Colombo who have helped us so materially by reporting on our experimental teas.

We are indebted to the Planters' Association of Ceylon who have kindly made accommodation available in their Headquarters for meetings of the Tea Research Institute Board and Committees.

The reports of the Scientific Staff are appended.

ROLAND V. NORRIS,
Director.

REPORT

OF

THE PATHOLOGIST

FOR THE YEAR 1948

On my return from leave on January 27th, the Mycology and Entomology Divisions were amalgamated to form a new division of Pathology. The amalgamation will facilitate internal organisation without in any way affecting our relations with the planting public.

Staff.—Mr. D. R. Kemp, B.Sc. arrived in Ceylon on April 6th to take up his duties as Mycologist in this division.

Advisory.—406 consignments of specimens were received for examination. No pest or disease other than Blister Blight was unduly prominent.

Publications.—In addition to papers written for the Institute's publications the following have been prepared for publication in technical journals :—

Loos, C. A.—Notes on free-living and plant-parasitic nematodes of Ceylon 5. *Journ. Zool. Soc. India.* (In press).

—— Notes on free-living and plant-parasitic nematodes of Ceylon 6. *Jour. Zool. Soc. India.* (In press)

—— *Calonectria theae* n. sp. — the perfect stage of *Candelospora theae* (Petch) Wakefield. *Trans. Brit. Myc. Soc.* (In. press).

—— *Amphicaeta grevilleae* n. sp. on *Grevillea robusta* seedlings. *Trans. Brit. Myc. Soc.*. (In press).

Gadd, C. H. and Loos, C. A.—Further observations on the spore growth of *Exobasidium vexans. Trans. Brit. Myc. Soc.* (In press).

Ranaweera, D. J. W.—Observations on the life cycle of a Chalcid parasite *Tetrastichus coccinellae.* (Awaiting publication).

Ranaweera, D. J. W.—Three new species of *Tetrastichus.* (Awaiting publication).

Blister Blight.—The study of the fungus *Exobasidium vexans*, which causes Blister Blight, has been continued and an account of the work has been prepared for publication in an early number of the *Tea Quarterly.*

In Dimbula, Blister Blight gradually disappeared from the fields during the early months and became somewhat difficult to find in March. The disease began to become more evident in May and its incidence increased to a maximum in July. Rapid recovery set in during August and some

estates had a "rush" crop in September. For the remainder of the year the disease was relatively mild. South West monsoon conditions were far more favourable for the disease than those of the North East monsoon.

The foregoing is a fairly accurate account of Dimbula as a whole, but it is not true of every field in the District. The incidence varies from field to field, sometimes for no very obvious reason. Experience of the disease emphasises the importance of local knowledge, of the climate and characteristics of individual fields when applying control measures.

The most severely affected fields are those which lie in a mist zone where mist occurs on the majority of days in the year. Even in such areas bushes relatively free from Blister Blight are to be found. The best of these should be propagated vegetatively for supplying.

Brown Blight.—Brown Blight of tea was first recorded in Ceylon in 1899. Petch in 1923 reported that it frequently causes considerable damage on bushes which are just coming into bearing a few months after pruning, and he opined that it was worthy of serious consideration because of its attack on young leaf. Later observations showed that the attack usually followed tipping.

Before attempting to trace the connection between tipping and Brown Blight the following experiment may be of interest. The fungus associated with, and generally said to be the cause of Brown Blight is *Colletotrichum camelliae*. This fungus was grown in pure culture and its spores collected. Young healthy tea shoots consisting of three or four leaves and a terminal bud were placed with their cut ends in water. Some of the leaves were wounded either by cross-hatching their surface with a fine needle or by abraiding them with sand paper. Half the shoots were sprayed with sterile water as controls, and the others were sprayed with a water suspension of *Colletotrichum* spores. Two days later typical Brown Blight blotches occurred on the wounded leaves sprayed with spores. After five days the results given in Table 1 were recorded.

TABLE 1.

Inoculation of severed healthy tea shoots with spores of *Colletotrichum camelliae*.

	CONTROL			INOCULATED		
	Leaves.	Wounds.	Infected.	Leaves.	Wounds.	Infected.
Wounded	17	38	6*	20	46	42
Unwounded	13	0	0	13	0	3

* These occurred on leaves abraided with sand paper. Ten such wounds were made on the control leaves and twelve on inoculated leaves.

The experiment shows clearly that the fungus is not a virulent parasite and that wounds or other injuries are necessary before the fungus can gain entry into a normal healthy leaf. Only three positive infections were obtained on unwounded leaves, and one cannot rule out the possibility that very small unnoticed wounds were there when the leaves were sprayed with spores.

At the end of five days the dark brown areas extended somewhat beyond the wounds, and later they amalgamated and covered whole leaves. This rapid extension of the disease was somewhat unexpected. Cut shoots, however, can be maintained in water for a limited period only, and the fact that they soon die under such conditions suggests a lowering of their vitality. The extension of Brown Blight beyond the wounded area may be due to this lowered vitality with the result that the cells are no longer able to resist invasion.

This conclusion is supported by a few experiments made on healthy seedlings growing in pots. The leaves were inoculated with a suspension of *Colletotrichum* spores in water placed as globules on wounded and unwounded areas. Infection occurred at the wounds but the disease did not extend materially beyond them except for a few minute specks each surrounded by a small translucent zone a short distance beyond the main discoloured area.

On unwounded leaves the results were negative except in a few instances when a few minute dark specks each surrounded by a translucent zone were observed a little distance beyond the inoculum. Examinations of the leaf surface disclosed the presence of hyphae running from the inoculum to the minute lesions clearly indicating a connexion. It may here be stated that similar specks have been observed this year on leaves in the fields and that from each of the many examined, the fungus *Colletotrichum camelliae* has been obtained. It is somewhat curious, however, that similar small lesions were not observed before the advent of Blister Blight into the Island.

Sun Scorch.—The above experiments in addition to showing that *Colletotrichum* is not a virulent parasite suggest that leaves must be injured in some way before a normal attack of Brown Blight will occur. As Brown Blight frequently occurs after tipping the question arises: In what way does tipping cause injury to the leaves left on the bush?

Tea leaves which have grown and expanded under shade are extremely susceptible to sun injury when that shade is removed. The injury takes the form of a scorch, easily recognised by the reddened appearance of the damaged areas. When tippings are removed in bright sunny weather the leaves shaded by them often become sun-scorched. The sun-scorched areas later become invaded by fungi, principally *Colletotrichum*, and Brown Blight results. Only the sun scorched areas are invaded and then the progress of the disease ceases. The occurrence of the disease, is therefore, restricted to the short period after tipping. The removal of any type of shade will result in the same sequence of events if conditions are favourable.

Although *C. camelliae* will not attack or invade uninjured leaves it readily enters injured cells and rapidly causes their death. It then lives on the dead tissues. *Pestalozzia palmarum*, the fungus associated with Grey Blight, behaves in the same way on injured or sun-scorched leaves.

Exobasidium vexans.—This fungus, which causes Blister Blight of tea, has very different habits. It can invade young healthy leaves and stems in the manner described in a recent number of the *Tea Quarterly*. It differs from *Colletotrichum* not only in being able to invade healthy young leaves but also in being unable to live on dead cells. Its own life is

dependent on its host cells remaining alive. Of course the invaded cells are ultimately exhausted and killed, but not until the fungus has completed its life cycle and has produced a huge number of spores. At this stage the white blisters turn black. This is the normal blackening or 'drying out' of blisters.

Premature blackening of Blisters.—During the year it was noticed that many leaf areas invaded by Blister Blight often blackened before the blisters became white, i.e. before the fungus *Exobasidium* had produced its spores. This was found to be the result of a secondary invasion by *Colletotrichum*, the Brown Blight fungus.

Colletotrichum has been isolated on numerous occasions from prematurely blackened blisters and the following experiment demonstrates its effects. Young shoots were collected at a time when Blister Blight was prevalent in the fields. The leaves were washed with corrosive sublimate and sterile water to free them from adhering spores and growths. About half of them were sprayed with a suspension of *Colletotrichum* spores and the others were kept as controls. All were placed with their cut ends in water. The visible lesions on the leaves were classified according to their stage of development as (1) translucent spots (2) blister just forming (3) blister beginning to turn white. At the beginning of the experiment there was no blackening of any lesions but after five days the results shown in Table 2 were obtained.

TABLE 2.

Inoculation with *C. camelliae* spores of tea shoots naturally infected by *E. vexans*.

	CONTROL			INOCULATED			
Stage of Blister Blight	Lesions	Infected	% Infected	Lesions	Infected	% Infected	Increase of infection
Translucent spots	45	7	16	68	44	65	49
Just blistering	33	12	36	79	61	77	41
Just sporing	49	24	49	56	50	89	40
Total	127	43	34	203	155	76	

It will be noted that 34 per cent of the lesions on the control leaves became prematurely blackened. These infections had occurred naturally in the fields before the leaves were gathered. The effect of the spores sprayed on the leaves is seen in the increase in the percentage of infections which amounted to 76. The experiment shows that *Colletotrichum* invades Blister Blight areas equally readily at all stages of their development.

The cells invaded by *Colletotrichum* are quickly killed and, as in other experiments with cut shoots, the Brown Blight extended beyond the injured areas. When the leaves are not severed from the bush *Colletotrichum* is unable to invade areas beyond the cells injured by Blister Blight and the blistered areas only became blackened, as is to be seen in the fields.

The death of the leaf cells caused the immediate death of the Blister Blight fungus *Exobasidium* which was thereby prevented from sporing. The premature destruction of the primary parasite has resulted in a very marked reduction in the number of spores available to produce further infections. To this extent the secondary invasion by *Colletotrichum* or other similar fungi is beneficial, but it is unlikely to reduce Blister Blight to the status of a minor pest.

Cercosporella theae.—The fungus long known as *Cercosporella theae* has been transferred to another genus and its correct name is now *Candelospora theae*. Unfortunately the generic name *Cercosporella* has become the common name of a leaf disease of tea, and so we are in the unhappy position of having a Cercosporella disease caused by *Candelospora theae*.

This fungus has a second type of fructification which has been named *Calonectria theae*, Loos. It was first found in association with a collar canker of *Crotalaria anagyroides*. Later it was found to cause similar cankers at the collar of *Tephrosia vogelii*, and *Crotalaria Grahamiana*.

Cross inoculation experiments showed that conidia obtained from diseased Crotalaria plants attacked young, severed tea-leaves as readily as the conidia obtained from tea leaves with Cercosporella disease, but the fungus from tea was not virulent on Crotalaria plants. Although the two fungi can be distinguished by certain minor differences they are so closely related that they are best regarded as two strains or varieties of the same species.

Candelospora and Blister Blight.—On a few occasions the fungus *Candelospora* (*Cercosporella*) *theae* has been isolated from prematurely blackened blisters and from dead young shoots (arambu) in bushes severely attacked by Blister Blight.

An experiment was carried out to ascertain whether this fungus will behave like *Colletotrichum theae* in attacking leaves already invaded by *Exobasidium*. The method used was the same as for the *Colletotrichum* experiment, and the results five days after inoculation are given in Table 3.

TABLE 3.

Inoculation with *Candelospora theae* spores, of tea shoots naturally infected by *E. vexans*. Natural infections by *Colletotrichum* are shown in brackets.

	CONTROLS			INOCULATED.		
Stage of Blister Blight	Lesions	Infected	% Infected	Lesions	Infected	% Infected
Translucent spots	7	0 (1)	0	13	8	61
Just blistering	29	0 (3)	0	28	25 (3)	89
Just sporing	30	0	0	58	58	100

The leaves used for this experiment proved to have few natural infections of secondary fungi. The first sign of infection by *Candelospora* was the presence of minute red-brown dots on the *Exobasidium* lesions. Similar dots were not observed when *Colletotrichum* spores were used.

The dots rapidly enlarged and amalgamated until the whole lesion was discoloured. At this stage it was not possible to distinguish readily *Candelospora* from *Colletotrichum* infection. The results show that blister lesions are very readily invaded by *Candelospora* and that the percentage invaded increased as the blisters became mature.

Phloem necrosis.—Apart from the necrosis in the phloem of leaves, stems and roots, the symptoms of this virus disease are variable. The best known symptoms are the backward arching or curling of the leaves and the zig-zag shape of some young stems. During the early months a new symptom was observed in many bushes in the Kandapola area. The leaves after expanding normally, rotated through a semi circle so that they became upside down with the lower surface exposed to the light in the position normally occupied by the upper surface. In some cases a part of the leaf blade died as though from sun scorch. Examination of the dead areas, however, disclosed that the death was not due to a scorch and indicated that most probably it resulted directly from the virus.

Seedling disease.—An unusual disease of tea seedlings was reported from a low country estate. It was caused by the fungus *Sclerotium zeylanicum*. Although a common fungus in the low-country it rarely attacks tea seedlings. It forms a white, fleecy mycelium over the surface of the soil and surrounds the stems of seedlings killing them near ground level. After growing for some time the fungus forms small yellow ovoid bodies about the size and shape of mustard seed. These sclerotia will remain dormant for considerable periods before giving rise to a white mycelium again when conditions are favourable.

The case reported this year occurred amongst seedlings growing in sand, used as a germinating bed.

Grevillea seedlings.—A disease of young *Grevillea robusta* occurred in a nursery in the Kandapolla district. The plants, many of which were completely defoliated, were 2 or 3 inches high, but such leaves as remained attached were severely blotched. The dead areas ranged in size from small specks to patches involving almost the whole leaf. The fungus associated with this disease has now been described and named *Amphichaeta grevilleae* Loos.

Albizzia seedlings.—A disease of Albizzia seedlings was reported from the Maskeliya district. Brown spots occurred on the leaflets which later fell off, often leaving the seedlings denuded. The fungus associated with the disease was *Ceratophorum albizziae*. The disease was previously reported in 1940.

Shot-Hole Borer.—The collection of broken branches from the plots of the Passara manurial experiment No. 2 was continued throughout 1948. The plots were last pruned in September 1946 and this is the third 3-year cycle of the experiment. The second year of the 1946-9 cycle was completed in September 1948. The experiment will be continued till the end of the present cycle, September 1949.

The experiment was started in 1942 when the bushes were in their second year of a 2-year cycle. The cycle was extended to cover a 3-year period and since then the 3-year cycles have been continued.

TABLE 4.

Number of branches broken in 3.2 acres of tea during particular years of the cycle.

Year of cycle.		Cycle. 1940-3	1943-6	1946-9
1	...	—	2,657	5,167
2	...	52,695	29,250	17,283
3	...	23,884	15,777	

In Table 4 are shown the number of broken-branches collected each year of the cycles. The greatest number of breakages occur during the second year of each cycle and there is a marked diminution in the third year. The figures available at the time of writing for the third year of the present cycle indicate the probability of a similar reduction in this cycle also.

Although the number of branches collected during the second year of the first cycle (52,695) may have been abnormally large because none had been removed earlier, yet the total collected during the whole of the second cycle (47,684) was smaller. Collections during the third cycle are likely to be smaller still. It would appear, therefore, that the extension of the pruning cycle has proved beneficial in every way.

The amount of damage occurring in the field depends not only upon the number of shot-hole borers present but also upon the amount of manual labour performed in the field. Most of the breakages recorded result from plucking operations but other works, forking, weeding, etc. also cause breakages owing to the labour force moving between the bushes. The breakages in 1946-7 were more numerous than in 1943-4, both first years of their cycles, mainly because collections of foliage attacked by Blister Blight were made at regular intervals between April and November 1947. Breakages at Blister Blight collections during that period amounted to about 40 per cent of the total damage. In July 1948 about 40 labourers worked through the plots gathering an accumulation of 4 months' weed and in October 1948 all rows were forked instead of alternate rows as in previous years. These operations undoubtedly increased the number of broken branches, yet despite this the total today is less than that of previous cycles for the same period.

In Table 5 is shown the average weekly collections during the second year of the cycle. The cessation of blistered leaf collection at the end of November resulted in a marked decrease in breakages during the following month. There was a sharp increase in June, when as in preceding cycles damage was reaching its maximum. The figures confirm what has previously been reported, namely that damage resulting from Shot-hole borer attack reaches its maximum towards the end of the second year from pruning, and that the extension of the pruning cycle offers a satisfactory means of reducing the damage.

TABLE 5.

Mean number of broken branches collected weekly from an area of tea (3.2 acres) during the second year of the cycle.

	CYCLE.		
Month	1940-3	1943-6	1946-9
October ...	—	472	395†
November ...	—	320	276†
December ...	—	340	208
January ...	—	497	169
February ...	1205*	484	138
March ...	860	433	120
April ...	1579	559	145
May ...	1744	811	142
June ...	2450	846	617
July ...	2250	854	782
August ...	1729	751	521
September ...	1162	695	603

* Collections started. † Excessive breakages due to extra work in the plots.

Nettle Grub.—Nettle grubs were reported on nine estates in Uva, on six of which the outbreaks were sufficiently severe to cause considerable defoliation. On one estate the pest persisted throughout the year. Except for one estate in Haputale which reported the Blue-striped Nettle grub (*Parasa lepida*) the chief species responsible for the outbreak in Badulla and Passara was the Fringed nettle grub (*Natada nararia*).

Two estates resorted to spraying with soap and water as a measure of control but on one only did it prove effective. It is suspected that the failure of the other was possibly due to the poor standard of laundry soap used.

The collection and destruction of cocoons is simpler and more effective as a means of control than the hand picking of grubs. The latter method also has the objection that it causes a loss of larval parasites. Normally, these parasites control the pest efficiently and keep its number down to a negligible quantity. No accurate reason can be given for the occasional local increase in number of the Fringed nettle grub when it becomes a pest.

When, however, this nettle grub becomes so numerous as to be a pest, general observations suggest that its numbers are reduced more by disease than by parasites. The disease is known as Wilt, and judging from its effect in the Insectary it is very highly infectious. A diseased nettle-grub at first is yellow and somewhat inflated, but later becomes a flaccid brownish rotting mass with an offensive odour. How the disease is transmitted from insect to insect is unknown, and the few experiments carried out to determine this point have failed.

Tea Tortrix.—Towards the end of the year reports were received from a few estates that Tea Tortrix was becoming more noticeable. Examination of specimens, however, disclosed the presence of the parasite *Macrocentrus homonae* in every instance. Tea tortrix larvae were observed on

St. Coombs in November and December. Of the larvae collected in November (41) 56 per cent were parasitised while of the December collection (75) 64 per cent were parasitised. *Macrocentrus* cocoons collected from the field were kept under observation but no hyper-parasites emerged. The evidence is clear that *Macrocentrus* has not lost control and there is no reason to expect a major attack of Tea tortrix in 1949.

Scarlet mite.—This mite which for many years has been known in Ceylon by the name of *Tenuipalpus obovatus* Donn, has been examined by Dr. E. W. Baker of the United States Department of Agriculture, an expert on this group, who informs us that its correct name is *Brevipalpus australis* Tucker. He also observed amongst the collection sent him an immature stage of a second species *Brevipalpus inornatus* Banks. Our thanks are tendered to Dr. Baker for this information.

Argina argus.—The caterpillar of this moth is one of the commonest leaf pests of many species of Crotalaria though not of *C. anagyroides*. It normally feeds on leaves and only when these are finished does it turn its attention to pods and stems. On *C. Grahamiana* it behaves differently in that it first attacks the pods, eating the seeds, in preference to leaves. It has also been found to attack leaves of *C. agathifolia* lightly, but as the plants had no pods at the time it is unknown whether seeds would be preferred or not.

Crotalaria flea-beetle.—In January the leaves of *Crotalaria lanata* were badly attacked by a flea-beetle (? Longitarsus sp.) which made perforations in the leaves, both young and mature. Badly affected leaves were almost skeletonised. In February young *C. anagyroides* plants were attacked when about two weeks old, but the beetle had disappeared two months later without doing serious damage. During the later half of the year the same beetle was observed on the leaves and flowers of *C. Grahamiana* and *C. agathifolia* again without doing serious damage.

Adult female beetles were maintained in the laboratory for a maximum of 41 days feeding on *C. lanata* leaves but they refused to feed on *C. anagyroides* leaves. Eggs were laid near the surface of damp soil either singly or in clusters of from two to seven. A female might lay up to 9 eggs in one day and then lay no others for five days. The maximum number of eggs collected from one female was 117 which were laid over a period of 34 days, giving a daily average of 3.4 eggs. Other females kept under observation did not equal that performance and the average from six females was 1.9 eggs per day.

The eggs hatched in from 11 to 16 days, the average of 30 eggs being 13.8 days.

Attempts to raise the larvae beyond the first instar failed. The young larvae bored into young *C. anagyroides* roots but would not feed on roots or leaves of other Crotalarias. Other sources of food such as grass roots and potatoes were also refused.

Green Manure Pod Borers.—Considerable damage is caused annually by pod borers destroying the seeds of green manure plants while in pod Crotalaria and Tephrosia pods are invariably damaged by caterpillars which enter them and devour the seeds. The following observations were made during the year, of two common pests which cause most damage at St. Coombs.

Crotalaria Pod Borer.—Throughout the year at St. Coombs, particularly during fine weather, the Pea Blue butterfly (*Cosmolyce boetica* L) can be seen on the wing usually flitting around leguminous plants in flower, particularly Crotalarias. The female lays her eggs singly on flower buds, petals, leaves and stems but flower heads are preferred. The eggs are flattened spheres about half millimetre in diameter and rather less in height, pale green ornamented with numerous regularly placed white warts.

The eggs hatch in from four to six days when from each, a small, greenish, light brown streaked, slug-like larva emerges. A larva emerging from an egg laid on a flower or flower bud bores its way through the petals into the centre of the flower. There it eats the stamens and pistil but leaves the petals undamaged except for the circular hole through which it entered. Having consumed the sex parts it leaves that flower and enters another. In this way it does considerable damage as the vital parts of 8 or 9 flowers may be consumed by one larva before becoming full grown. The damaged flowers of course never produce pods. The larvae feed readily on Tephrosia flowers in the same way that they damage Crotalarias, but they do not enter Tephrosia pods.

When young Crotalaria pods are present on the plant the Pea Blue larvae bore rather large circular holes in them through which they enter and feed on the young seeds. The entrance hole is closed by a closely woven web which apparently prevents other insects from entering. When all the seeds are consumed the larva leaves by the same hole, after cutting away the web cover or by making another hole.

The larva feeds for 23 to 25 days during which time it may consume the seeds of as many as 8 pods. When full grown it leaves the pod or flower in which it has been feeding and pupates amongst fallen leaves or attacked flowers. The pupa is dark brown with a few black spots, about one to one and half cm. long and is covered by a loose silken cocoon. The pupal stage lasts from 11 to 14 days and then the Pea Blue butterfly emerges.

It will be noted that the larvae which do the damage spend most of their time within flowers or pods feeding on parts which cannot be reached by insecticidal sprays. For that reason spraying has not usually given efficient protection. The butterfly is so common and the eggs so numerous that it is surprising that any pods survive. That they do is probably due to the work of a parasite found to be very active in the fields.

Egg Parasite of the Pea Blue.—The parasite is a species of *Oligosita* (*Trichogrammatidae*) a minute wasp like insect which lays her eggs within the Pea Blue butterfly's eggs. The female parasite alights on an egg and then rather leisurely forces her ovipositor through the chorion (egg cover) and deposits an egg within. Fourteen or fifteen days later a full grown parasite instead of the destructive larva emerges. Sometimes two eggs, perhaps more, are laid within a butterfly's egg, but more than two adults have not been seen to emerge.

The beneficial effect of this parasite is well illustrated by the following observations. A clump of *Crotalaria anagyroides* plants growing in a somewhat isolated position near the laboratories were found to bear eggs of the Pea Blue caterpillar, none of which were parasitised. Seven parasites obtained in the laboratory from other sources were liberated amongst

these plants. A fortnight later, 20 eggs were collected all of which proved to be parasitised. Weekly collections, each of 20 eggs, were made during the next sixteen weeks and on no occasion did the percentage of parasitisation fall below 80 per cent.

The results obtained during these observations may have been unusually favourable as although eggs collected from the fields were usually found to be parasitised, the highest percentage obtained was 45. All collections made during September, October and November contained parasitised eggs but two collections in December, each of 20 eggs, contained no parasites though collections made from the isolated plants showed 93 and 72 per cent parasitised. No explanation can be offered for the apparent sudden disappearance of the parasites in the fields.

Larval Parasite of the Pea Blue.—Another species of parasite has been observed to emerge from Pea Blue pupae. A collection of 45 Pea Blue larvae collected in the field were fed in the laboratory until they pupated. When the pupae were from 6 to 10 days old grubs emerged from 3 of them. The grubs immediately pupated making puparia, at first red but later turning black, attached to the host pupal shell or other object. Fifteen to seventeen days later 3 Tachinid flies (? *Calozenillia* sp.) emerged. These flies were about the same size as a house fly.

It seems probable that the Tachinid parasite attacks the Pea Blue caterpillars when they have left one pod or flower and are searching for another.

Tephrosia pod borer.—(*Etiella zinckenella* Tr.) Damage to Tephrosia pods is caused by a different insect, a moth, which is never seen to fly around the plants during the day. This Pyralid moth has a wing spread of 1.5 to 2 cms.; the wings are grey brown with purplish markings. The female lays her eggs singly amongst the hairs of young pods to which they adhere firmly. The egg when newly laid is white, somewhat rectangular, about 0.6 × 0.4 mm., with one end rounded and the other tapering slightly. The egg is placed usually with the tapering end directed towards the pod. After 2 or 3 days the egg becomes reddish due to the presence of red patches. It hatches in from 8 to 11 days.

On emerging from the egg the larva is white with a brown head and white hairs. It later becomes green and finally greenish purple when full grown. It then measures 1.5 to 2 cm. long and 2 to 4 mm. broad.

The young larva begins to bore into the pod as soon as it emerges from the egg. While doing so it makes around its body a curious covering of silk with which small pieces of pod hair and pod are entangled to form a tube, both ends of which are open. Excretal pellets are ejected from one end. The hole when complete is just sufficiently large for the larva to squeeze through, which it does leaving the silken gallery outside. The presence of the gallery and excretal pellets indicates the position at which a larva has entered.

Within the pod the larva moves to a young seed on which it begins to feed. It continues to make a silk web but merely as a loose cover, and not in the form of a tube. Having consumed one seed it moves to another and during its larval life will consume 5 or 6 seeds. The remaining undamaged seeds will normally reach maturity. Often, however, two or more larvae enter the same pod and then all the seeds are likely to be destroyed.

When the larva has completed its development it makes an exit hole through which it leaves the pod and enters the soil. It first makes an oblong earthern cell at a depth of about three quarters of an inch and then spins a silken cocoon in which it pupates. The pupa is brown, about 1 cm. long and is about twice as long as broad.

In the laboratory the egg stage lasts from 8 to 11 days (average 9½) the larval state 33 to 38 days (average 36) and the pupal stage 21 to 28 days (average 24). The moths lived from 20 to 22 days and laid on the average 145 eggs. Unfertilised females lay eggs which remain white without developing the reddish tint of fertile eggs, and do not hatch.

This borer has not been found in Crotalaria pods though in the laboratory the larvae will bore into them and feed on the seeds. The reason why Crotalarias are free from this pest is probably that the female moth prefers the hairy Tephrosia pods for their eggs. She places her eggs deep amongst the hairs to which they are attached.

This insect is well protected against natural enemies. No egg parasite has been found in eggs collected from the field, though the species of *Oligosita* which attacks Pea Blue eggs will readily attack *Etiella* eggs in the laboratory. Possibly the position of the eggs amongst the hairs of the Tephrosia pod is a form of protection. The larval stage is passed within a pod and later the insect is hidden in the soil. At this stage it is more vulnerable but so far no natural enemies have been located.

Larvae can usually be found in small numbers whenever young Tephrosia pods are present in the field. At St. Coombs they were particularly abundant from August to mid-October. Old pods appear to be immune to the pest as in the laboratory young larvae failed to bore through their harder shell.

Tetrastichus coccinellae Kurdj.—This insect is a parasite of Lady-bird beetle larvae. Larvae of the Lady-bird beetle *Chilomenes sexmaculata* were seen feeding on Aphids on *Tephrosia vogelii* in March and more than 50 per cent of them were found to be parasitised by this species of *Tetrastichus*. An account of the life history of this parasite is being published elsewhere.

C. H. GADD,
Pathologist.

REPORT

OF

THE AGRICULTURAL CHEMIST

FOR 1948

Staff.—The Agricultural Chemist acted for the Plant Physiologist after Dr. Tubbs' departure on July 8th. There have been no staff changes in the Department.

Advisory.—498 letters were received and 320 despatched.

Publications.—Soil Fertility Problems: Some Historical Aspects. (Presidential Address Section B (Agriculture and Forestry) Ceylon Association of Science, 1947). Proceedings 3rd. Annual Session, part 3 pp. 49-61, 1948.

The Work of the Agricultural Chemistry Department 1927-48. A brief account of the research activities of the department during the tenure of office of the writer has been completed for publication.

The preparation and collection of the data for this review and the completion of a guide to the field experiments to assist my successor, when appointed, has occupied a great deal of time during the past months. Data which would normally have appeared in this report have been included in the forthcoming bulletin. Consequently only a few interim results are presented here.

Phosphate Response.—In last year's Report, mention was made of work on the availability of phosphate to plants on the tropical red earths which constitute most of the tea soils of Ceylon. Those results suggested that the plant finds little difficulty in absorbing phosphoric acid after a period of at least a year has elapsed following application. During the year under report further striking evidence has accumulated showing that after as long as four years phosphate has not reverted to compounds relatively unavailable to some plants.

For some years the phosphate plots on the Passara Sub-Station manurial experiment have been failing to give a response similar to that found at St. Coombs. They are now in a state in which they show a yield that is inferior to the no-phosphate plots, though up to the present the difference between the two is not statistically significant. Nevertheless the trend is plain enough, and it is only a question of time before an actual depressant action will be ascribed to phosphate on this experiment. The most obvious suggestion to make in order to account for this anomalous result was that a systematic error had somehow crept into the experiment.

This hypothesis was explored in several directions. Counts of bushes were made on the plots to see if by reason of vacancies or drains, boulders or shade trees, the distribution of bushes was favourable to the no-phosphate plots. The heterogenity that exists is not sufficient to account for an effect of the size encountered. Nor are shade tree irregularities of sufficient import to suggest that they are competing selectively for phosphoric acid. As far as can be ascertained there is nothing defective in the experimental set up itself and this is confirmed by the fact that the anomaly is confined to phosphate plots: the nitrogen treatments appear to function normally.

There is always the possibility that the anomalous effect is a purely local one concerned with soil type. This experiment lies on a soil derived from a rock which is not of very widespread occurrence in tea areas. In order to glean further information advantage was taken of the fact that on St. Coombs soil, where phosphate has a moderate but consistently good effect on tea, weeds are exceptionally sensitive to phosphate. They thus constitute a very good indicator for phosphate deficiency or availability. In March the whole experiment grew weeds undisturbed until July. The harvesting and weighing of the weeds during the Uva drought proved a very difficult task and only a trial sample of one block out of four was completed. The experiment has been repeated and results covering the whole experiment will shortly be available. The data from the one block are instructive. Table II sets out the yields of weeds from eight plots, four of which received phosphate.

TABLE I.

Dry weight of weeds. (lb. per plot). (Passara) March 6th—July 6th, 1948.

Treatment.		Plot.	Row A.	Row B.	Total.
N 0 0	...	I A1	3.70	2.94	6.64
0 P 0	...	A2	5.96	3.92	9.88
0 0 K	...	A3	4.63	3.08	7.71
N P K	...	A4	19.20	13.13	32.33
0 0 0	..	I B1	2.21	2.27	4.48
N 0 K	...	B2	1.68	2.43	4.11
N P 0	...	B3	4.85	4.45	9.30
0 P K	...	B4	13.26	8.44	21.70

N = nitrogen: P = phosphate: K = potash.

The fact that manuring is carried out as in estate practice, on alternate rows, divides the plots into two parts which are indicated by the descriptions Row A and Row B. During the past cycle, and in the present one so far as it has proceeded, no fertiliser has been given in a first year following pruning. The reasons for this has been dealt with in previous reports. Its import for the present discussion is that whilst Row A was manured in 1945 with 30 lb. of P_2O_5 and in 1947 with 60 lb. making a total of 90 lb. of P_2O_5 Row B received its last dose in October 1944 (30 lb. P_2O_5). The effect of more recent and more liberal manuring is seen in the generally higher yield level in Row A on plots scheduled to receive phosphate.

By combining plots receiving phosphate and comparing them with the corresponding combination that is deficient in that nutrient, the data take the form shown in Table II.

TABLE II.

Phosphate effect (Superphosphate).

Total dry weight in lb. for treatments in Table II.

		Row A.	Row B.	A & B.
P.30	...	43.3	29.9	73.2
P.0	...	12.2	10.7	22.9
Sum	...	55.5	40.6	96.1
Difference	...	31.1	19.2	50.3

The effect of phosphate is unmistakable in both rows. It is of particular interest that the response to phosphate in row B is so high, considering that four years have elapsed since the last manuring operation. Whatever be the nature of phosphate reversion in the soil, it is such that the plant finds no difficulty in absorbing the nutrient and in using it efficiently after nearly four years.

Amalgamating Rows A and B in Table I it is at once seen that the real centre of interest is in plots IA4, and IB4. The former receives all three nutrients, the latter P and K. Their yields are several hundred percent better than any of the others. The nature of the responses is further elucidated in Table III.

TABLE III.

Phosphate responses. Lb. dry weight.

P-P0	...	5.4	8.1
PN-N	...	2.7	
PK-K	...	14.0	42.2
NPK-NK	...	28.2	
		50.3	

Table III shows that the response of 50.3 lb. set out in Table II can be divided into two very unequal parts; a small one of 8.1 lb. where P is given in the absence of K, and a large one where P and K are both at work. The efficiency of the P effect is thus dependent on a sufficiency of potash. No such effect is apparent on the St. Coombs weed trial, but the Passara soil is derived from Khondalite which is less rich in potash than the St. Coombs rocks.

The analysis of the weeds gives further information. Only Row A samples were analysed. The increased phosphoric acid content is noticeable in all weeds subject to phosphate manuring but the large changes in phosphatic content are not to be found where phosphate and potash are in combination as was the case with yield response. The highest increments in phosphatic composition are from those plots which received no nitrogen (Table IV).

TABLE IV.

Effect of Phosphate on composition of weeds
percent P_2O_5 in dry matter.

Treatment.			Difference.	Mean.
P-P0	...	.4948-.3059 ;	.1889	.2140
PK-K	...	.5476-.3086 ;	.2390	
PN-N		.4156-.3059 ;	.1097	.1235
NPK-NK	...	.4262-.2888 ;	.1374	

These results show that there is a definite difference between the behaviour of the Passara and the St. Coombs soils in respect of phosphate response, though they do not at the moment shed direct light on the failure of response in tea in contradistinction to weeds.

The study of phosphatic response in both tea and weeds has hitherto been confined to experiments, both at St. Coombs and at Passara, where the form of phosphate used has been superphosphate, an easily soluble and an easily reactive form of phosphate. It is all the more remarkable therefore that the effectiveness in face of reversion should be as marked as it is. This year the opportunity has presented itself to carry out a similar study on weed response on areas where the phosphate used was mineral rock phosphate which is insoluble and much less reactive, though its efficiency on acid soils with high rainfall appears satisfactory.

On the weed ecology experiment where the succession of weeds is being followed under a series of treatments and with long term weeding operations, the yields from a six month weed crop were as follows.

TABLE V.

Response of weeds to Mineral Phosphate and Muriate of Potash.
lb. dry weight (Plot totals).

	K0	K60	TOTAL	DIFFERENCE
P15	99	191	290	92
P30	161	270	431	109
TOTAL	260	461	721	...
DIFFERENCE	62	79		17

This experiment explores the phosphate effect at a lower level (P. 15) than any other previous experiment. It will be remembered that the existing NPK experiment gives no response either with weeds on tea above P30. If the tentative findings of this new experiment are confirmed, showing a substantial response between P15 and P30, it will confirm the suspicion that P30 is at or near the optimum for these soil conditions. It is to be

noted that the mineral phosphate appears to be an efficient nutrient so far as weeds are concerned. Furthermore there is not the dependence on potash level that was remarked in the Passara experiment.

Potash Responses.—The annual report for 1946 reviewed data on the subject of the potash response of young tea not yet in bearing. No response was found after a twelve month growth period either in foliage or in wood. This was in contradistinction to the results of a similar and previous experiment carried out at the Tocklai Experiment Station. At the beginning of 1948 this same experiment was taken into bearing. It consists of two halves on sites about a third of a mile apart. Each site carries two replications. When the tipping yields were examined it was found that a very substantial response to the heavy dose of potash (K60) was visible, and that the effect was consistent on both sides. The figures are.

TABLE VI.

Response of young tea to Potash manuring.
Dry weight of tippings. lbs. per acre.

	Section I.	Section II.	Mean.
K0 ...	224	140	182
K60 ...	272	171	222

It appears probable that this effect is a short lived one, only detectable on early growth after pruning, for it has not appeared in the subsequent flush yields. It is also probable that the failure to find it previously was due to the fact that growth was allowed to go on too long before the estimate was made.

The weed data of Table V are taken from the same experiment and confirm the response to heavy doses of potash.

It is now possible to attempt a provisional summing up of our phosphate and potash data as illustrated by responses to both tea and weeds.

(1) Phosphate is effective on both tea and weeds up to 30 lbs. per acre, and as far as weeds are concerned, the mineral rock phosphate is of the same order of efficiency as the soluble superphosphate.

(2) The effectiveness of superphosphate is not severely affected by reversion to non-available forms even after four years.

(3) On the Passara soils phosphate is behaving in an anomalous way and this requires further investigation. The presence of potash appears to be a necessary factor in securing response to phosphate from the weed flora. At St. Coombs this is not the case either on old tea or on new clearings opened out of patna.

(4) A distinction can be drawn between old and new tea land as regards potash response. On old tea weeds are unaffected by potash manuring at the K20 and K40 levels; but on patna clearings K60 gives a response of 50 per cent. The view may be hazarded that on old tea a potash reserve has been built up as a result of liberal manuring in the past.

Mechanical Plucking.—The department has given technical help in experiments with the Tarpen Mechanical Plucker designed by Mr. B. D. Fay. The main point of interest is whether the use of mechanical apparatus with its different technique of bush preparation will give yields of the same order as hand plucking, and whether the distribution of yield in the cycle will be altered. In the preliminary trials the mechanical plucker was found to give yields substantially behind those of the hand plucker, but with experience of bush management a great deal of the loss has been wiped out. The method is one which will repay very careful attention and holds the promise of giving leaf of adequate standard for manufacture.

Acknowledgments.—As this is the last annual report to come from my pen, I take this opportunity of thanking my colleagues, both senior and junior, and my planting friends for the inspiration and encouragement that has so constantly proceeded from our association and co-operation together.

T. EDEN.
Agricultural Chemist.

REPORT

OF

THE PLANT PHYSIOLOGIST

FOR 1948

Staff.—Dr. F. R. Tubbs relinquished the post of Plant Physiologist on July 8th, and Dr. T. Eden, the Agricultural Chemist, assumed acting charge. Otherwise there have been no changes in staff.

Advisory Correspondence.—375 letters were received and 349 despatched.

Clonal Selections.—There are at present 154 clones planted out in clonal rows in the field. Of these 42 were selections from material showing a recognisable degree of resistance to Blister Blight. None of the clones in this latter category will be in bearing for some time. Of the 80 clones which are in plucking some show themselves markedly susceptible and others moderately resistant. The question is sometimes asked whether selection for blister blight resistance should receive a first priority. The answer is in the affirmative for two reasons. Selection does no more than establish a probability that a high yield can be attained. That probability can be minimised by poor cultural treatment or disease. Secondly experience at present suggests that good yielding capacity is no less frequent amongst resistant bushes than amongst susceptible types.

The system adopted up to the present for judging the prospective value of a clone has been to grow a 30 unit row for each one. This has been excellent for demonstration, for studying the type of branching and plucking tables and for certain preliminary records of yield, preparatory to weeding out of unsuitable types. Before consistent behaviour in yield can be claimed a much more stringent technique is needed. A method of accurately determining the respective yields of a large number of clones (25) at the same time has been put into operation on a small scale and this may well form the basis of larger and more definitive trials in the near future. It is necessary to put this on record because it is often thought that at this present time the last word has been said on the yield capacity of existing clones. This is not the case as the following examples will show.

TABLE I.

Effect of one clone on another.
Estimated yield per acre for 40 consecutive plucking rounds.

Year of Planting	1937-38	1941-42	1937-38	1941	1942
Clone No. and Position	23	687	25	960	999
Yield 1-40	910	115	925	215	230
Yield 41-80	1,005	100	1,665	130	330
Total	1,915	215	2,590	345	560

Clones 687 and 960 are both poor yielders according to these records. They may in fact be so but the mother bushes were chosen because they had the reputation of being good yielders. Given adequate conditions they should be capable of giving high yields. The fact that they are flanked (No. 687 on both sides, and No. 960 on one side) by a high yielding spreading clone suggests strongly that this is the interfering factor.

In some instances duplicate rows of a clone have been planted. The variability in performance to which location gives rise is shown in Table II and in some examples is considerable.

TABLE II.

Variability in single rows. Yield per acre for 40 rounds (2 series).

Clone	Row A.	Row B.
43 ...	725	... 860
216 ...	810	1445
331 ...	1020	1370
777 ...	1485	1670
1294 ...	1190	1250
1526 ...	1320	1880
1530 ...	1205	1240

In assessing these results it is legitimate to be guided by the better of the two yields. It is evident that by resorting in the first instance to single rows there is the danger of missing, because of chance circumstances, a potentially good clone. This is not of great importance at this stage. Out of the examples quoted above if Row A had comprised the whole of the information available, Nos. 43 and 216 would have been discarded as below par. In the case of 216 the odds are 50/50 that such a rejection would have been wrong. There are eleven clones which over the same time period of two years plucking have given yields estimated as higher than 800 lb. per acre. Their distribution is as follows:—

Yield Range.	No. of clones in range.
800- 899 ...	4
900- 999 ...	5
1000-1099 ...	1
1100-1199 ...	0
1200- ...	1

The process of selection must necessarily be a continuous one, the aim being to use the best available at any time whilst continuing to search for even better material.

Yields from Seed Bearers.—Continuing the practice of recording the horijan seed bearer yields so as to accumulate reliable data, Table III, IV and V give the customary data relating to yield, with analysis of sinkers, floaters and empty seed; and the distribution by months of the total crop harvested.

TABLE III.

Yield from Seedbearers (1948).

No. of Bearers.	First year of bearing.	Total.	SEED Sinkers per cent.	SEED Floaters per cent.	SEED Empties per cent.
14	1942-1944	5531	46	46	9
16	1945	3281			
28	1946	3771			
18	1947	1781			
3	1948	211			

TABLE IV.

Percentage of empty Seed (1948).

JAN.	FEB.	MARCH	APRIL	MAY	JUNE
7	10	16	10	10	9
JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
6	5	3	8	16	23

TABLE V.

Percentage of Crop harvested monthly (1948).

JAN.	FEB.	MARCH	APRIL	MAY	JUNE
9.8	6.3	5.4	4.4	10.3	8.8
JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
15.9	12.7	10.3	7.9	4.7	3.7

VEGETATIVE PROPAGATION.

The importance of Drainage.—When the present method of propagating cuttings was worked out, high figures for successful rooting percentage were obtained. From time to time batches of material fail to give high percentages even though, with similar material, these have previously been attained. It is evident that conditions unfavourable to rooting occur which are not yet fully recognised at the time that they supervene. There is no doubt that over-watering is one of the most serious causes of failure on estates as a whole. Examples have been seen at the height of the Uva drought where nursery cuttings were moribund from this cause. Watering daily should never be necessary, and twice a week is a norm for dry weather. This presupposes that the beds are well watered, that the soil is suitable, and that the beds have an adequate drainage layer. Nursery beds have come to notice whose soil contains practically no organic matter and whose clay content is over 50 percent. Soils of this nature should be easily recognisable at sight as unfit for propagation. Anyone wishing to assess the suitable frequency of a watering technique can easily do so by setting aside a few beds and watering one every day, another every two days and so on. If the state of the soil and the cuttings is examined under these regimes a working principle can soon be established. There has been

a general falling away from the practice of making drainage layers for propagation beds. This is to be deprecated. At the time the technique was worked out (Tea Quarterly, 14, 1941, p. 102) the effectiveness of this layer in securing good results was so obvious that the matter was not put under formal experiment. This has now been done in an experiment that includes the comparison between drainage layer and no drainage layer, and also the effect of recently added green manure for reconditioning propagation beds. The experiment is still in progress but the results to hand are highly suggestive. After four months the percentage of rooted cuttings under the various treatment combinations was as follows. (Table VI).

TABLE VI.

Rooted cuttings under various treatments
Percentage rooted.

	With green manure.	Without green manure.	
With drainage layer	38	44	— 6
Without drainage layer	35	31	+ 4
Difference	3	13	— 10

In the preliminary stages of rooting the effects of poor drainage due, either to absence of drainage layer or to the presence of moisture retaining semi-decomposed green manure, are plain. Green manure makes little difference on an undrained bed which is already retentive enough of moisture to promote poor rooting. In conjunction with a drainage layer its effect is to annul to a large extent the good promoted by the broken metal. It can, therefore, be presumed that drainage layers are essential to continued success, and that if beds are reconditioned with green manure they should be kept free from cuttings for some months and should be thoroughly stirred at intervals to secure homogeneity before being re-employed.

Type of cutting.—The early work on propagation gave conflicting results on the question whether red or green wood cuttings were best. This was not unnatural since the material used was very heterogenous. Now that a large number of clones have been established the opportunity has been taken to re-explore the matter under better controlled circumstances. This has been done in conjunction with a variety of other treatments in an experiment using six thousand cuttings.

TABLE VII.

Effect of type of cutting and Hormone treatment on rooting of 30 clones.

	Red Wood				Green Wood			
Hormone	Nil	A	B	C	Nil	A	B	C
Percent rooted	49	45	49	48	59	51	51	54
	48				54			

The bottom line of Table VII shows green wood to be the most succesful and this is fully substantiated by statistical analysis of the results. It is doubtful, however, whether it would be practically important to use only green cuttings because this would reduce the available material by almost half in the most instances.

The same experiment tested out a growth hormone in a new form. Originally (Annual Report 1940 and 1941) a solution was used. This proved beneficial in the sense that it speeded up rooting, but made no difference to the eventual success of the operation. In the different type of hormone used this year the active principle is mixed with a powdery excipient. The technique is thereby much simplified. The cutting is merely dipped in water first and then in the powder. After tapping, to knock off surplus powder, the cutting is immediately inserted in the bed. In this experiment the precaution was taken of making the hole in which the cutting was to be inserted, with a skewer. There was therefore no risk of the hormone being wiped off in the process of insertion. Three different grades of hormone were used, intended for different degrees of hardness of the wood. The results have been negative. None of the differences between hormone treatment and the 'nil' control are significant. Further work with this compound will be needed in order to elucidate the reasons for its ineffectual performance in this case. It may be that with tea, which, in comparison with other species regularly propagated vegetatively, is slow and difficult to root, the disadvantage of not having a solution to penetrate the tissues is a grave one. Perhaps the active principle does not come into contact with the tissues in sufficient concentration to act effectively. Some overriding factor is at work which only further investigation can elucidate. The series of 30 clones were divided into two sets one comprising the better 15 and the other the worse in order to ascertain whether the hormone was effective on either taken separately. The result of this examination was also negative. The hormone works very satisfactorily on cuttings of other species, e.g. Hibiscus.

Clonal Variation in Rooting.—Emphasis has been laid on the need to select on the basis of ease of rooting since clones vary considerably in this. In the experiment to which reference has already been made the range of rooting percentage after 4 months extended from 22 percent to 84 percent with a mean of 51. The number of clones tested was thirty.

T. EDEN,
Acting Plant Physiologist.

REPORT

OF

THE BIOCHEMIST

FOR 1948

Staff.—There were no changes in Staff during the year. The Biochemist was away on a tour of the N. E. Indian tea districts during June and early July.

Correspondence.—642 letters were received and 718 despatched.

Advisory Work.—Since the Colombo Market resumed buying by auction sale the advisory activity of the department has increased rapidly and reached a record level towards the end of the year when there was general anticipation of a reopening of the London Market.

There is no doubt about the fact that competitive sales stimulate interest in, and attention to, tea manufacture.

During the period when the whole of Ceylon's crop was bought in bulk, the advisory work of the Department fell to a very low level. At the same time, the general standard of manufacture fell and is still below the 1939 level but is undoubtedly rising rapidly as the incentive to pay more attention to leaf standards and quality increases.

A total of 48 factories was visited and 32 of these visits were made towards the end of the year. 76 organised rolling programmes were drawn up and 61 drawings of roller fittings supplied to estates and engineering firms. Advisory work has therefore occupied a great deal of time. A factory visit takes at least one day and sometimes two, or even three, if a lengthy journey is involved. Each rolling programme also takes a considerable time to draw up. Reports on factory visits are often quite lengthy especially when drier tests and rolling programmes are involved.

Visitors to the Institute have been numerous and although two days a month are earmarked for visitors, the total number of visits made n other days greatly exceeds the number on visitors' days. It must be stressed that unexpected visitors cause much interruption of work.

Lectures.—Lectures, illustrated by lantern slides, on the tour of N. E. India were given to the following District Planters Associations: Dimbula, Dickoya, Uva, Kandy, Morawak Korale, and Sabaragamuwa.

General.—The time available for research or even direction of research work is very broken. To keep a balance between advisory and research work is a very difficult and at times harassing problem.

Moisture Determinations.—395 moisture content determinations were made for estates apart from the daily and invoice samples from St, Coombs Factory.

Whilst the Institute is prepared to carry out these tests for any Estate temporarily unable to do their own, or for the purpose of checking estate figures, every effort should be made by estates to carry out these tests themselves.

BIOCHEMICAL.

Volatile matter in tea.—In the report for 1947 the early stages of an investigation into the volatile matter of tea leaf were described. Steam-volatile matter at various stages of manufacture was measured and found to fall rapidly during the course of manufacture. When this was first discovered and confirmed (a considerable amount of work was done on the actual method of analysis which gave very variable results until standardised) the first reaction was one of great surprise or even perhaps excitement. Volatile matter connotes esters and essential oils and an apparent heavy loss during the course of manufacture suggested a large new field of research into methods of preventing such loss. Other lines of investigation, however, have failed to indicate such marked losses of flavour, apart from which the volatile matter in low grown leaf was actually higher than that in high grown leaf.

The explanation has proved to be a simple one but very interesting. Tea leaf contains quite large amounts of pectin (the material which causes jams to jellify). During the course of fermentation this breaks down to pectic acid by reason of the activity of an enzyme and liberates methyl alcohol.

$$\text{PECTIN} \xrightarrow[\text{ENZYME PECTASE}]{\text{ACTIVITY OF THE}} \text{PECTIC ACID} + \text{METHYL ALCOHOL}$$

The major part of the steam volatile matter measured in the previous experiments was, therefore, methyl alcohol and the reaction involved must be studied before any other volatile matter can be investigated.

The actual formation of pectic acid during fermentation is also of some considerable interest. Tea leaf is comparatively rich in pectin — the content varying from 4-8 per cent on the dry matter of the leaf. The formation of pectic acid may have a marked effect on the physical character of fermented leaf and also prevent further fermentation after the latter, has become sufficiently viscous or jellified. There are indication that pectic acid forms a gel in fermented leaf but there are several difficulties to be overcome before we can be certain about this point.

Since a 2 per cent pectin solution will set to a gel there is normally ample pectin present in tea leaf to jellify if other conditions are favourable.

However, there is no doubt about pectase activity during fermentation because methyl alcohol has been collected from fermenting leaf. An apparatus was devised which enabled fermenting leaf to be swept with a rapid current of humidified air. This carried away the methyl alcohol as it was formed. The air was washed by bubbling through a series of tubes containing water. Four successive tubes were sufficient to wash out all the methyl alcohol.

Table I shows the results obtained:—

Experiment.		Milligrams of Methyl Alcohol per 25 grams of fermenting leaf	Moisture	Milligrams of Methyl Alcohol per 100 grams dry matter
1. Five different rolling treatments.	A.	4.56	48.0	35.1
	B.	4.44	49.3	35.0
	C.	3.20	54.0	27.8
	D.	4.84	47.5	36.9
	E.	3.80	53.0	28.7
2. Clivemeare Roller.	A.	3.14	56.5	28.9
	B.	4.10	50.2	33.0
3. Clone No. 9 withered and minced.		3.04	58.0	29.0

The formation of methyl alcohol is obviously a normal feature of fermention and is not greatly affected by the technique of rolling or by the nature of the leaf.

In addition to methyl alcohol, a very small amount of a yellow crystalline material was obtained by extracting the water in the tubes with ether. Even after a long series of experiments it was not possible to collect enough for identification. The crystals had a very strong and pleasant odour of "tea."

The enzyme (tea pectase) involved in these reactions has been studied and purified and results will eventually be published in a Scientific Journal. The optimum Pʜ and temperature of the activity of this pectase appears to be 7.0 and 50°C respectively.

Pectase activity in the component parts of flush.—The total pectase activity, irrespective of the amount of pectin present in the various parts of the flush, is shewn in Table II:—

TABLE II.

	Milligrams of Methyl Alcohol evolved per 100 grams dry weight of leaf. Experiment I.	Experiment II.
Bud ...	128	224
1st Leaf ...	191	291
2nd Leaf ...	172	202
Stalk including leaf stalk. ...	323	454

The total pectase activity of selected (uniform as possible) flush from a series of clones is shewn in Table III.

We are indebted to the Physiology Department for the material,

TABLE III.

Clone.	Milligram of Methyl Alcohol per 100 grams dry weight of leaf.	Clone.	Milligram of Methyl Alcohol per 100 grams dry weight of leaf.
T5	368	T.16	183
T13	335	T.21	498
T2	223	T.19	284
T1	323	T.15	231
T4	285	T.22	360
T3	257	T.18	343
T9	726	T.23	276
	712	T.24	264
T26	225		
T20	252		

T9 is the non fermenting Clone.

Pectin Content of Tea Leaf.—Since the total pectase activity may depend partly on the pectin content of leaf further analyses were made of the component parts of flush. Results are shewn in Table IV :—

TABLE IV.

	Per cent Pectin in dry weight.
Bud	4.94
1st leaf	6.09
2nd leaf	4.68
3rd leaf	4.97
Stalk	7.59

Pectin in withering.—During withering there appears to be a rise in both total and water soluble pectin.

Sample	Water Soluble Pectin % D. W.	Pectin insoluble in water % D. W.
Green Leaf	3·62	0·92
Withered Leaf	4·24	1·60
Fermented Leaf	3·84	1·60

ANALYTICAL.

1. Deposits in drying room.

Two estates sent in Caffeine deposits from ceilings above or near driers. One sample contained 75 per cent of Caffeine. The deposition of Caffeine appears to be due to excessively high air flow or high exhaust temperature.

2. Two samples were examined for crude fibre in a case where leaves although not coarse plucked appeared to be fibrous in nature. The leaf contained 10.446 per cent against a normal figure of 9.68 per cent.

3. Samples of corroded metals from a factory where a direct fired heater had been installed.

There is a tendency to blame direct fired heaters for all corrosion taking place in the factory after their installation.

In one case it was thought that jute hessian was being attacked but it was eventually found that it was the natural deterioration of 11 oz. hessian which only lasts 3-4 years. 14 oz. hessian will give about 10 years' of service with care and some patching but 11 oz. hessian begins to deteriorate rapidly after approximately 3 years service.

The Sulphur dioxide contained in the exhaust of a drier heated by a direct fired heater will, when used for withering, attack unprotected ironwork to some extent. A coat of paint is a fully adequate protection. The M.C. Clips used for fixing electrical wiring will corrode when they are made of tinned copper and fixed with iron screws. In this case the Sulphur dioxide attacks the iron screws and the iron sulphate formed causes an electrolytic type of corrosion.

Galvanised iron clips which are the normal type of clip are not susceptible to attack.

As Iron Sulphate is deliquescent it may spread over quite an area and form a white powder when it dries. This sometimes gives an erroneous impression of the extent of the attack. For instance the cut end of a galvanised sheet or small pieces of flat iron sometimes used for clips may be attacked and the wet iron sulphate will then run down the sheet. On dry days when the iron sulphate dries it looks as though a white sulphate has formed all over the surface of the sheet. On brushing off this adventitious deposit a bright intact surface will be found below. This of course only applies when the galvanised iron is in good condition. If rust or corrosion has already started the sulphur dioxide may accelerate the process but if a thick coat of rust has already formed it will protect the iron below it. The extent of attack by sulphur dioxide is limited by the formation of resistant films.

There is no evidence that sulphur dioxide from direct fired heaters causes corrosion or damage of any considerable proportion. Tinned copper clips should be avoided in wiring tea factories or should be fixed with brass screws.

4. A sample of fire-brick which had proved unsatisfactory was examined and found below specification. It proved to be of Indian origin and was sold on good faith as "imported" but had been obtained through "service disposals." It is essential that only the highest quality of fire-brick should be employed in oil fired furnaces.

MANUFACTURE.

Under present conditions accurate experiments on tea manufacture are quite impossible. With the major part of the tea market supplied by bulk buying, the balance of the tea sold on the open market is subject to extreme variations governed by the amount of various grades offered for safe, seasonal buying and fluctuations of rate of exchange, shipping facilities, transport difficulties in N.E. India and a host of other distributing factors.

All manufacturing experiments must ultimately depend on Tea Tasters' opinions and these opinions are bound to be influenced by demand. The only real value of a sample of tea is the amount it can command in rupees and cents. A good sample of the difficulty in question is the seasonal demand from the Middle East for tippy teas. When this demand is strong the presence or amount of tip almost entirely determines the value of a tea within the norrow limits of most experimental samples.

Fortunately it is possible to some extent to overcome difficulties of this type by obtaining analytical reports based on relative appearance, colour, strength, pungency, quality and flavour as well as the valuation. Although at various times the Taster's opinion on the value of the tea is influenced to different degrees by Market demands for appearance or colour or flavour, it is of considerable value to know that a certain experiment has had a marked effect on some particular character.

There is no doubt, however, that when the market demands, say, teas of high standard of appearance, the tea taster notes small differences which he would disregard at other times. To revert to my opening remarks under this heading it is, therefore, impossible to carry out accurate experiments under present conditions.

Taking all these points into consideration, in determining experimental programme it is at once obvious that investigations must be limited to practical problems. There have been literally hundreds of modifications to rollers, battens, roll breakers, driers and so on during the past say fifty years without any fundamental change in the product. In fact the tea market resists any such change and, apart from minor modifications in grades to meet blending and packeting requirements, demands a rigidly orthodox and typical product distinguished only by district and season.

If care be taken to ensure uniformity of leaf a quite remarkable range of technique can be employed in manufacture without affecting the commercial value of the resultant teas although different Tasters may comment on improvement or otherwise according to specific requirements, especially when samples are sent as experimental samples.

Variations of leaf on the other hand, cause very marked differences in character of both dry leaf and liquor and are the most probable cause of effects noticed in short term experiments. In our opinion experiments

(apart from purely mechanical experiments) on tea manufacture are most unreliable and misleading unless carried on over a period of several months including extremes of seasons.

The improvements in machinery and equipment which have been really worthwhile are those which afford increased control and facilitate handling of leaf.

Two remarks made to me during the year have remained in my memory because they are apt and also because both were made by individuals with a keen sense of perspective who were looking at the tea industry as a whole and who were not confused by detail. The first case was from a Director of a large Company who previously had planted in Ceylon for a large number of years. Revisiting Ceylon after a lengthy period in London he was only concerned with the broader views of tea manufacture. His Company as a whole was very concerned with rolling methods and had a wide variety of rollers and fittings, both E.P. and Batten/pressure cap. Reviewing all he had seen of the variety of methods he remarked that "It did not seem to make a — bit of difference so long as the leaf was all right."

The second case was from a widely experienced Visiting Agent who returned to Ceylon after an absence of a year. He was concerned with the broad lines of policy of the Company he represented and his chief concern was the "utter confusion which seemed to exist in matters relating to rolling" and he gained the impression that many superintendents were bewildered by the variety of possibilities and conflict of opinion.

During the course of advisory work I have also been increasingly concerned by the confusion which exists in all detail relating to the choice of roller battens and the year's experiments have been designed to solve this problem.

Batten and Pressure Cap Rolling.—As the main problem is with batten replacement and repairs, this was given priority. In the report for 1947 mention was made of a smooth cone which when fixed to the door of a roller helps to improve circulation. So long as the angle at the base (Angle at A in Figure 1) of this type of cone does not exceed 45° it does not smash leaf against the jacket. It must be of a considerable size to exercise any effect on circulation. The base should therefore be as large as possible but must clear the jacket by one inch on either side. For 34" and 36" rollers a height of 5 inches is recommended and this height should be increased to 6" for 40" and 44" rollers.

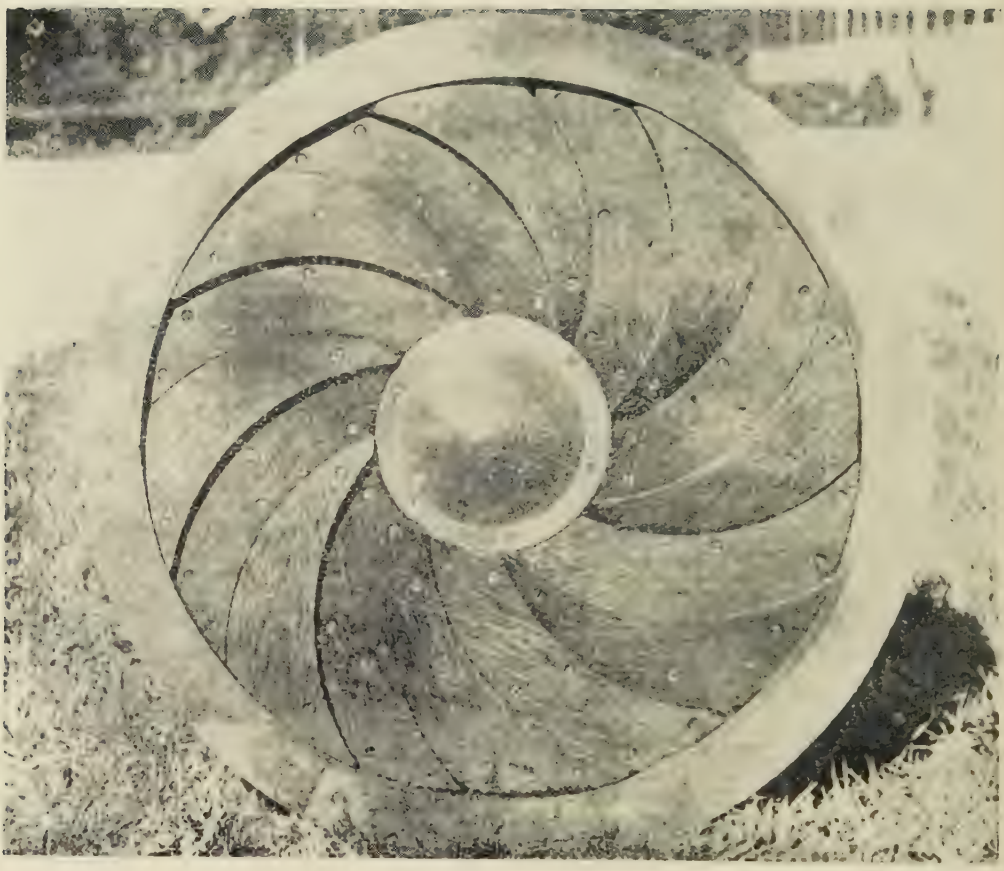
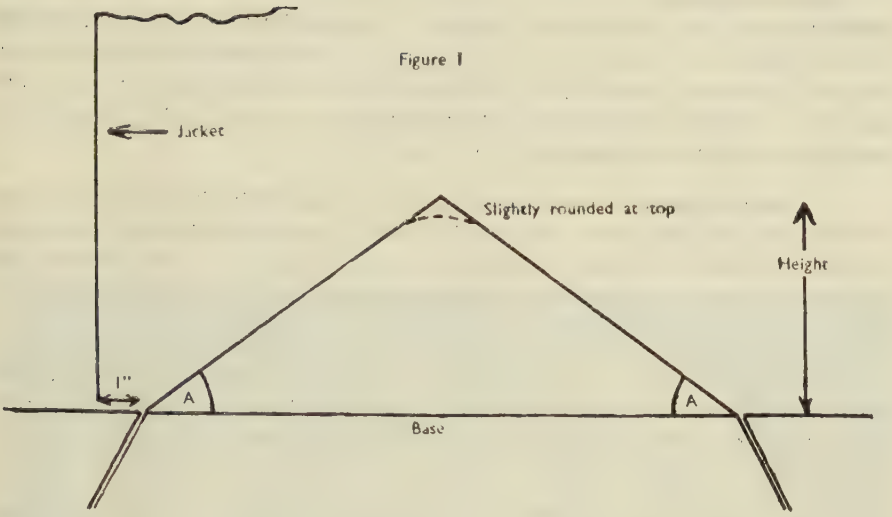


PLATE I.

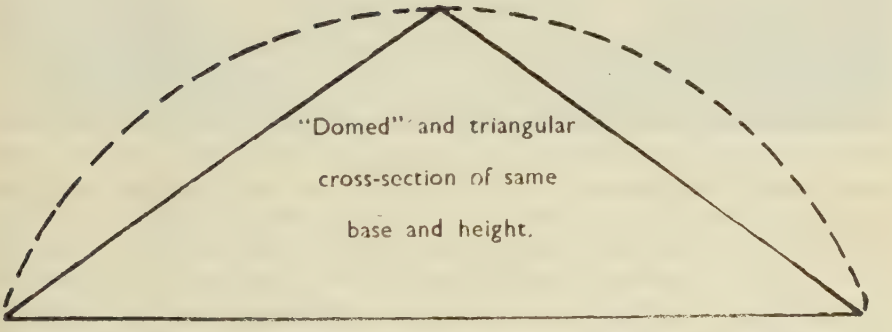
PLATE II.

Figure I



The cone must be a true cone with a triangular cross section. If it is domed as shewn in Figure II it will smash leaf to a fibrous pulp.

Figure II



1. **Short Battens, Crescent, Lamont Michie.**—Plates I and II shew the arrangement with Crescent battens. It is strongly recommended that the cone should be cast in brass by a properly equipped Engineering Firm. Messrs. Walker Sons can supply the cone for their Crescent battens and the same fitting will serve for Lamont Michie battens.

This arrangement gives an excellent twist but is not suitable for the production of large amounts of dhool. It is excellent for first and second rolls of high grown leaf and is particularly suitable for low-country manufacture, especially when high big bulk percentages (25-30 per cent) are required. If lower percentages of big bulk are wanted it is advisable to employ a different arrangement for later rolls.

2. **Long Battens, M. and S.**—In co-operation with the Colombo Commercial Company we have adapted the conical centre to M. and S. battens. The battens are continued on to the surface of the cone and merge into it about a third of the distance from the base to the apex. Plate III illustrates the arrangement.

The Colombo Commercial Company have provided standard drawings for all the normal types of roller and "Fadeaway" cones may be obtained to fit existing M. and S. battens. Drawing number 4429.C should be quoted in this connection.

It is essential that the M. and S. battens should be of the standard type otherwise results will be disappointing. Modifications of battens are often made at the request of Superintendents or Visiting Agents and repairs by estate carpenters are a further cause of deviation. For these reasons a number of existing M. and S. type battens are not of standard design and it is essential that this point should be checked before attempting to fit fadeaway cones. The M. and S. batten is a Colombo Commercial Company patent and it is strongly recommended that fadeaway cones should be fitted by this firm.

This arrangement is suitable for all rolls, a good twist and low dhool outturn being obtained in early rolls with light pressure, and a high dhool outturn in later rolls with moderate pressure.

The advantage of being able to use any roller for any task is very considerable and greatly facilitates the organisation of the rolling room at different crop levels.

Batten/Pressure Cap Technique.—As a result of extensive advisory experience and many hundreds of experiments both with orthodox and unorthodox manufacture, I am being forced to the conclusion that the most important considerations in tea manufacture are control and organisation. There are many possible variations of technique, and experience will suggest essential modifications to meet conditions in different districts and the different demands from various sections of the tea trade. Some estates specialise in, say, colour and strength obtained by a long wither, others in special grades, generally fine appearance, and so on. Sometimes estates are well known for a particular character which has become almost a tradition. It is very seldom that special equipment is necessary for the production of these teas. The most important thing is to ensure a good standard of leaf and then to organise and control manufacture in order to maintain the particular character so far as

PLATE III.

seasonal variations allow this to be done. Thus a MARK becomes established and once a requtation is established a premium is almost assured. Experiments in commercially run tea factories should be avoided as far as possible when a satisfactory technique has been established.

The lure of new batten types which are claimed to put five cents per lb. on to prices should be resisted until there is some very good reason to make a change.

For all normal purposes the two batten types described above are sufficient for replacement of existing tables. They can be rigidly standardised and replaced from time to time without upsetting the factory routine. The cones should be cast in brass as wear is most marked at the centre of the table. If the battens are properly installed with good sound timber they will last for many years especially if brass inserts are fitted. In our experience the employment of estate carpenters for rigidly standardised work of this nature is not satisfactory and we recommend that all work on roller tables should be entrusted to properly equipped Engineering Firms.

Charge.—In the interests of economical working the amount of leaf charged into a roller must be as high as possible. Excessively light charges waste potential output of expensive machines, labour, and power. Overcharging on the other hand is false economy and there is no difficulty in coming to a decision on this matter. So long as the leaf in a roller circulates freely the machine is not overcharged. The central cone assists circulation and therefore to some extent increases capacity.

The guiding factor is the dhool outturn required. So long as the pressure required to give the necessary dhool outturn does not stop the circulation of leaf and cause it to cake into one solid mass, a roller is not overcharged. If the application of pressure immmediately stops circulation (in rollers fitted with cones as described above) a reduction in the amount of leaf should be made. A good test of circulation is to stop the roller while the pressure cap is down and to examine the state of the contents of the jacket when the pressure cap is then raised. If there is anything more than a few inches of caked leaf on top of the jacket the roller is overcharged. With fully satisfactory circulation there will be a gap on one side where the jacket has receded, and at the bottom of which the table should be visible. Battens and fittings on the pressure cap, unless the pressure cap is specially shaped, as in the case of Davidson's rollers, should be removed, as they impede circulation.

Rolling Periods.—The norm must be regarded as four thirty minute rolls, but it is most unwise to lay down any hard and fast rules. For the highest quality in flavoury seasons it may be advisable to reduce this to four twenty minute periods or even three twenty minute periods. For very high standards of appearance with long wiry O.P. it may be necessary to run to six thirty minute rolls. In this latter case the Crescent or Lamont Michie batten with plain cone is advisable.

Dhool Outturn.—Since juice is literally "wrung" out of the leaf in a tea roller it is essential to avoid too rapid a reduction in size. First dhool should not exceed about 10 per cent and the leaf remaining in the bulk should be almost entire. This can be tested by soaking the bulk in water and allowing it to open out. When a satisfactory twist is obtained whole pieces of flush twisted into one unit will be found. The first dhool is mostly bud and tender leaf. Incremental dhool percentages thereafter are logical and seem to give good results. The actual amounts must be based on the percentage of big bulk which is required.

Roll Breaking and Sifting.—Much depends on the mesh in the roll breaker and a dhool figure should be specified in terms of roll-breaker mesh. As there was a demand for larger leaf grades during the early part of the year experiments were carried out with No. 4 mesh. The result was markedly in favour of the normal No. 5 mesh.

Grade	Appearance.	Colour	Strength	Pungency	Quality	Flavour	Comparative Valuation Cents
			Standard No. 5 Mesh				
B.O.P.	S.W.	A.W.	S.W.	E	S.W.	—	—5
F.P.	S.W.	S.W.	S.W.	E.	S.W.	—	—3
Fannings	E.	S.W.	S.W.	E.	S.W.	—	+1

Note.—S.W. = slightly worse
A.W. = Appreciably worse
E. = Equal.

The No. 4 mesh teas shewed all the symptoms of under rolling.

There appears to be a strong case for No. 5 mesh throughout roll breakers. If the tray is solid where the leaf falls on to it and the machine fed at the correct rate, reasonably even dhools are obtained. Dhool outturn is partially dependent on the rate of feeding the roll breaker. It is low when the machine is overcharged and unduly high and uneven when the machine is undercharged. Unevenness is more marked when there are "pockets" which retain leaf.

Little appears to be gained by double roll breaking. It involves more labour and excessive handling.

Epicyclic Pressure Rolling.—A fairly full account of our work on Epicyclic Pressure Rolling was published in the 1947 report.

Further experience has convinced us that the method must be limited to use with leaf of good standard. Poor fibrous leaf when rolled in E.P. Rollers gives brownish fibrous teas which compare unfavourably with the product from batten/pressure cap rollers.

With reasonable standards of leaf, results with E.P. rolling are good and may well suit the requirements of London Blenders when they can buy direct. Two of the rollers on the commercial side of the factory are being reconverted to batten/pressure cap arrangements (St. Coombs has carried out its entire rolling programme on E.P. rollers during the past two years) and comparative invoices are to be manufactured for a year or so thoroughly to test the relative merits of two processes.

There is scope for further experiments on rolling periods with E.P. Rollers. Short rolls appear to give better results than normal 30 minute rolls. A series of experiments designed to compare 3 × 20 minute E.P. Rolls with 4 × 30 minute E.P. Rolls gave results favourable to the shorter rolling period.

Grade	Appearance	Colour	Strength	Pungency	Quality	Flavour	Comparative Valuation Cents
	3×20 Rolls taken as standard for comparison						
B.O.P.	S.B.	S.W.	S.W.	—	E.	—	—2
F.P.	E.	E.	S.W.	—	E.	—	—3
Fgs.	S.B.	E.	S.W.	—	E.	—	+6

Note.—S.B. = slightly better
S.W. = slightly worse
E. = Equal.

The longer rolling period gave a black fannings which had a high market value at the time of the experiment. It will be noted that the higher value of the 4 × 30 minute fannings was based entirely on appearance.

Long Term Experiments.—Until market conditions change there is little scope for experiments on new methods of manufacture. Little further progress can be made until we can test the actual sale value of the types of tea produced.

Fermentation.—The presence or absence of malty character in teas is a puzzling feature of manufacture. Some years ago we conclusively demonstrated that maltiness has no connection with firing. Maltiness cannot be induced by high firing however high the temperature employed.

It is possible that maltiness is due to bacterial action secondary to normal fermentation. If teas are fermented for long periods they sometimes acquire a malty character but, of course, lose strength, pungency and quality. An experiment in which both dhools and bulk were inoculated

with small amounts of 24-hour-old fermented leaf was carried on for a period of a week or so. The intention was to culture "malty" strains of bacteria and to give them a chance to exert their influence during the course of normal fermentation. Domestic methods of making junket and cheese are carried out along similar lines when a small part of each days make is saved for use on following days to serve as an inoculum.

There were indications of partial success and it is intended to obtain some leaf from a factory which produces a marked malty character in an attempt to accentuate the effect.

Many factors are involved and it is improbable that sufficient control over any bacteria responsible for maltiness will prove practicable. It may well be that jat or type of leaf are mainly responsible for maltiness.

ACKNOWLEDGMENTS.

Throughout the year we have received all the help asked from Tea Tasters in both Colombo and London and we are very grateful to them. Research on tea manufacture depends ultimately on the care and attention given to the Tasting of experimental samples.

J. LAMB,
Biochemist.

ANNUAL REPORT FOR 1948 OF THE TEA SMALL-HOLDINGS ADVISORY OFFICER GAMPOLA.

The work done during the period under review was in the nature of a "Competition" which was held amongst the small-holders in tea in Udu Nuwera. Competitions of this nature are an incentive to good work. They afford an opportunity for meeting a large number of small-holders from one given area, when problems that face small-holders can be discussed and assistance rendered. The last Competition in this area was organised in 1935.

There was an appreciable increase in the number of entries this year due mainly to their soundness economically. The average price paid for Green Leaf stood at over 20 cents per pound. There was more ready money with small-holders since the war, which they were prepared to invest on improvements to their holdings.

There were 236 entries — an entry from nearly every village in Udu Nuwera. The Chairman and members of the three Village Committees were most helpful in getting small-holders interested in this Competition. Each Committee offered a cash prize of Rs. 50 in addition to the Institute's contribution.

The minor Headmen were also very helpful and it was through their keenness that we had so many entries.

The first week in January saw the close of the previous year's Competition held in Yati Nuwera with the distribution of Prizes.

We had with us on that occasion the Minister of Education, the Hon. Mr. E. A. Nugawela, and the second member for Kadugannawa, Mr. H. R. U. Premachandra. We take it as a compliment that they should have found time to attend our function, in the midst of important State duties. The interest they have taken is most encouraging and gives more confidence to the small-holders for better work, and we may take it as a sign that they appreciate the work the Institute is doing on behalf of the large number of small-holders.

Advisory Work.—Though most of my time was taken up with the work that was being done in Udu Nuwera, several visits were paid to areas in Yati Nuwera and Uda Palata, some at the request of small-holders, where my help was sought, especially when a field was being pruned. Every effort is made to give "pruning" my personal attention, the "Rim-lung" method being advocated as the best method, and the majority have taken to it. Eighty eight (88) villages were visited during the year and advisory work carried out. Twelve meetings were held during the year.

There was a very good attendance of small-holders at these meetings, which was a great source of encouragement.

Village Welfare Societies.—The Societies have recently been encouraged by Government and a Society exists in every minor Headman's area. Considerable amount of keenness is being shown and the attendance at meetings has been fair. I have attended several of these meetings held in the different villages, the main purpose being for the upliftment of the Rural areas. If these Societies continue to function as they are at present, there is every likelihood of village conditions improving. The Police, Excise, Medical and Agricultural Departments give these Societies every assistance, attend their meetings and try to create a better understanding.

Green Manure and Shade.—The value of growing and using Green Manures such as Gliricidia, Albizzia and sunflower has been fully realised by small-holders, and every small-holding has its quota of green manures. The practice of growing sunflower on the upper tips of drains as hedges has been encouraged.

The great demand for Albizzia as a timber has subsided and prices have fallen considerably.

I am trying to discourage small-holders from growing Albizzias on their holdings, but to grow them in their fences, as the heavy shade from these trees will encourage the spread of "Blister Blight."

Plucking and Pruning.—Bad plucking will continue until such time as poor quality teas are saleable in the open market. When prices are good, as they have been in the past few years, quality matters very little and factory owners, especially the "Bought Leaf Trade" has demanded quantity which must necessarily produce bad plucking.

Some form of legislation would, in my opinion, be the only remedy for this. It is more than likely that if small-holders are compelled to produce leaf of a good quality, they will benefit by it in more than one way.

As for pruning, the village pruner is capable of doing a very good job; what he needs is more supervision and a remuneration in keeping with his work. Every effort is made to get small-holders to inform me when their fields are due for pruning. When they seek my advice and assistance I spend a morning with them supervising their pruning.

Labour.—The labour situation has eased off considerably and more labour is available, but at rates much above the standard wage. Some of the rates paid are Rs. 2 per male cooly, Rs. 1-25 per female and the plucking charges are 4 cents per pound green leaf. This is for a 5 hour or 6 hour working day.

Weather.—The weather conditions this year were much more satisfactory than in the previous year except for the rather severe drought we had in September.

General.—Conditions are still far from normal which is a serious handicap for progress on small-holdings. The cost of food-stuffs, and other daily requirements, is still high and much above the pre-war prices. A very large proportion of the small-holder's earnings are spent in this way.

In conclusion, I must express my cordial thanks to the Village Committee Chairmen, Members, who have made grants to meet part of the costs of these Competitions, for their valuable assistance and co-operation in the work and also the Chief and Minor Headmen for their very willing co-operation.

R. L. ILLANKOON,
Small-Holdings Officer, Gampola.

REPORT

OF

THE SMALL-HOLDINGS OFFICER MORAWAKA

(SOUTHERN PROVINCE) 1948.

I was appointed to this post on the 13th February, 1948, and before settling down in the area I spent five weeks at the Institute and in the other two areas where small-holdings work is carried out in order to grasp the essentials of the scheme. Although small-holdings work had been carried out in this Division some years back there were no records available of such work at all that were handed over to me. Therefore a considerable length of time was spent in reorganising the whole scheme, and I feel, thankful to Mr. F. P. Jayawardana who worked a few weeks in this area prior to me, for making my task easier by collecting information in regard to the spread of Tea holdings in a part of my Division.

Sphere of activity.—The area under my supervision includes the following D.R.O's Divisions :—Morawak Korale, Weligam Korale, Kandabada Pattu, Gangabada Pattu and Hinidum Pattu. The extent of holdings below 10 acres is approximately 3,000 acres, while those of larger size needing my supervision amounts to perhaps a further 2,000 acres.

Weather.—According to records maintained at Allen Valley Tea Factory at Waralla, in the heart of the chief Tea District Morawak Korale, there had been 158.35 ins. of rain during 1948. Excepting in the month of January when there was only 1.48 ins. of rain, rainfall was fairly well distributed throughout the year with a reasonable number of wet days every month. At no time did we experience unduly heavy showers as in previous years such as to cause floods and disorganise normal agricultural operations.

Advisory work.—In order to adhere to some system I concentrated mainly on Morawak Korale during the period under review. But I kept my contacts with the other areas too, often enough to maintain interest in the tea owners of those areas. 375 visits were paid to small-holdings and a reasonable number of holdings above 10 acres were also visited for advisory work. Records of such visits are registered and progress sheets are maintained for all holdings and observations recorded after subsequent visits in order to gauge any progress.

Inorganic manuring was unknown to most small tea growers in the area and permits were obtained for those who showed interest in tea manuring.

With a view to maintaining the price in bought leaf factories, the merits of good plucking were explained to small tea growers and they themselves derived the actual benefits by getting good prices for their green leaf in such instances. In several factories rates paid for green leaf have varied between 23—26 cents per lb.

A large number of holdings were opened up in tea during the year. Such holdings were visited at the time of the preparation of the land and contour system of planting was advocated wherever it was practicable.

Diseases.—Mild attacks of "Blister Blight" have been prevalent in a number of larger estates, but they did not attain a degree of danger as upcountry. Every effort was made to advise Holders as to the measures to be taken to avoid attacks.

Other Activities.—During the year I had also the pleasure of visiting a number of bigger estates at the request of the proprietors, and many matters such as systems of pruning, planting, shade requirements, etc., were discussed in detail with them.

A largely attended propaganda meeting of the small holders was held in October at Beralapanatara.

An attempt was made to keep in touch with the people in their various moods of social life. I also attended the meetings of the Planters' Association, Village Committees and the Division Days of the D.R.O.'s in order to keep in contact with the Village Headmen.

My thanks are due to the D.R.O.'s of Morawak Korale, Hinidum Pattu and Kandabada Pattu for the co-operation they extended in the organisation of my work, and to their Headmen for sparing their time very generously whenever I wanted their services. The Chairman, M.K.P.A., has always been very enthusiastic about the small-holdings work and was a source of inspiration.

K. P. ABEYEWICKREMA.
Small-Holdings Officer, Morawaka.

The Tea Research Institute of Ceylon

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